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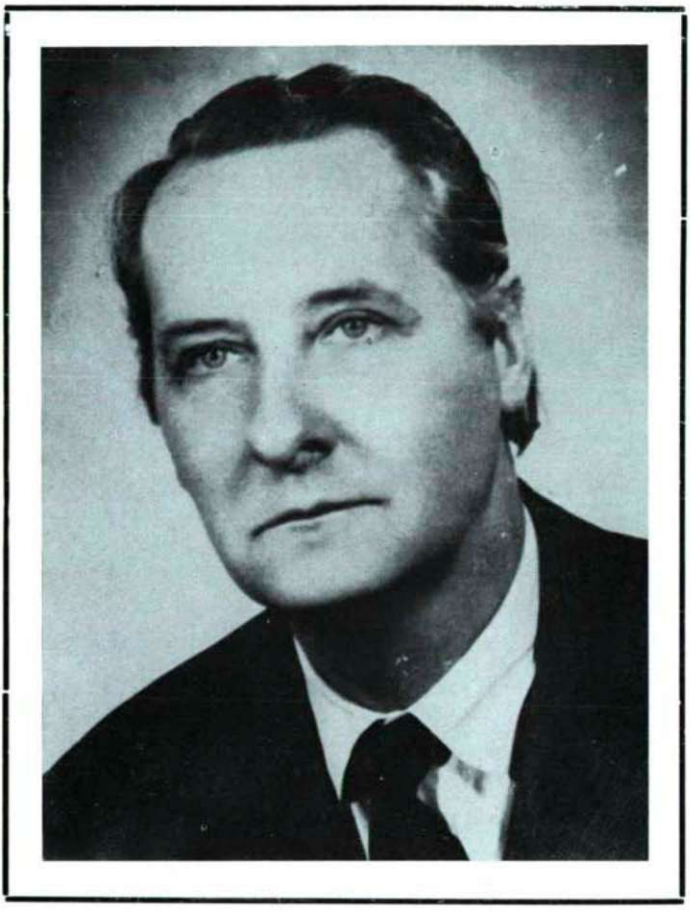

PROF. DR. GABRIEL KOLOSVÁRY
1902—1968

IN MEMORIAM PROF. DR. GABRIEL KOLOSVÁRY

Gabriel Kolosváry was born in Kolozsvár (Cluj) on August 18 1901. His father was University Professor Dr. Bálint Kolosváry, a distinguished scholar of private law. He finished his primary and grammar school studies in Kolozsvár (Cluj) from 1907 till 1919, having taken his final examination at that secondary school. He began his University studies in Kolozsvár, too, finishing them in Szeged, after the University had been removed here. From his professors, mainly István Apáthy's lectures had the greatest influence on him, and he remained a devoted admirer of his in all his life. In 1925 he graduated at the Szeged University, taking first his degree of zoology and geology, and getting in 1926 a diploma qualifying him for teaching in secondary schools. In 1923—1929 he was employed at the Institute of Zoology of the University in Szeged, in 1929—1954 in the zoological, resp. in the plaeontological departments of the National Museum of Hungary. In the meantime, in 1931, he became a honorary lecturer (privat-docent) at the University in Szeged. As a museologist, he made offical collecting study-tours in Italy, Jugoslavia and Transsylvania. Since 1954, hi was professor of the University in Szeged, leading first the Chair of Systematic Zoology and, from December 1st 1967, the Chair of Zoo-Morphology and Systematic, created by re-organization. Since 1960, he was corresponding member of the Hungarian Academy of Sciences. In 1956, the distinction of the Honoured Worker of Education was conferred upon him. In 1965, he won the Bogdánffy prize of the Hungarian Hydrological Society.

His scientific activity is conspicuously rich, the number of his scientific monographs is more than 900. He wrote two books, with the titles „Harvest-spiders of Hungary" and „Fishing and settling at the Tisza". Until his death, he was the leader of the Cooperative of Tisza-research, as well as the

editor-in-chief of the publication series Tiscia. Before World War II, he treated first of all of spiders and harvest-spiders. He was a world-known arachnologist. He studied also the living world of sea with a passionate interest. He elaborated the *Echinodermata* material of the old Hungarian expedition „Najade", investigating the Adriatic Sea. Until the end of his life, he remained an ardent researcher of the cirriped crabs (Cirripedia).

After World War II, requested by the Hungarian National Geological Institute, he began investigating the fossil corals of Hungary. In this field, as well, his activity is of permanent value. Requested by foreign Institutes, he elaborated also Czechoslovak, Jugoslav and English fossil corals, and extinct cirriped crabs obtained from the territory of U.S.S.R. In the interest of his investigations, he made study-tours in 1959 in Moscow, in 1964 in Czechoslovakia, in 1966 in Romania, in 1967 in the German Democratic Republic.

A systematic and organized investigation of the Tisza began under his leadership in 1955. Leading a co-operative of about 25 members, he sailed over the whole Hungarian sector of the Tisza. Later on, with the co-operative of his students, he organized an expedition for investigating the Tisza in every year. The results of the Tisza investigations are recorded and discussed in the papers of the series *„Das Leben der Tisza"* and in the volumes of the publication series Tiscia.

The foreign connections of Gabriel Kolosváry were of wide extension, his professional correspondence covered the entire world.

He lectured on an up-to-date level, in a progressive spirit.

With Professor Gabriel Kolosváry's demise, we have lost a warm-hearted man of very humane thinking and a very prominent scientist.

Dr. A. HORVÁTH,

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A COMPARATIVE HISTOLOGICAL EXAMINATION OF THE LEAF EPIDERMIS OF SOME SOLANUM SPECIES

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(Received September 1, 1968)

In my previous paper (Juhász, 1966) the leaf epidermis of some specimens of *Solanum* species were investigated, all of them being exposed to different environmental influences. After having valued the tissue marks of the leaf epidermis, we concluded that the quantitative tissue features of leaf are considerably influenced by ecological factors. The length and width of stomata resp. their ratio, the size, index and relative number of stomata have changed the least.

There arose the question whether the above-mentioned epidermal characteristics of different *Solanum* species grown in the same environment show differences considerable enough for separating, identifying the single species. Fifteen *Solanum* species were selected for being investigated. The taxonomical classification of the species examined, according to Bitter's system, is as follows (Hegi, 1927).

Genus: *Solanum* L.

I. Subgenus: **Archaeosolanum** Bitt.

1. *Solanum laciniatum* Ait.
2. *S. aviculare* Forst.
3. *S. aviculare* Forst. var. *albiflorum* Cheesem.
4. *S. simile* F. Muell.
5. *S. symonii* Hj. Eich.

II. Subgenus: **Eusolanum** Bitt.

a) sectio: *Morella* (Dun) Bitt.

6. *S. nigrum* L.
7. *S. alatum* Moench
8. *S. luteum* Mill.
9. *S. triflorum* Nutt.
10. *S. boerhavii* Thell.

b) sectio: *Dulcamara* (Dun) Bitt.

11. *S. dulcamara* L.

c) sectio: *Lycopersicum* (Dun. pro. gen.) Wettst.

12. *S. humboldtii* Willd.

d) sectio: *Tuberarium* (Dun) Bitt.

13. *S. chacoense* Bitt.

III. Subgenus: **Leptostemum** (Dun) Bitt.

Sectio: *Andromonoeceum* Bitt.

14. *S. sodomaeum* L.

15. *S. giganteum* Jacqu

The identification of the single species has been carried out on the basis of the fundamental works of De Candolle (1852), Bitter (1912), Baylis (1954, 1963), as well of the material of the *Solanum* collection of the National Botanical Collection in Budapest.

Material and method

The 15 *Solanum* species, selected for being investigated, have been grown in small plots of the experimental plantation of the Botanical Gardens in Szeged. The plants have developed here under identical conditions of soil, light and temperature. Their flowering took place in different times, according to the time of growing. Samples were always taken from the full-grown leaves in the middle region of the shoot of plants in flowering. The living leaves collected were fixed in Juel's mixture. From the middle part of the leaves fixed preparations were made by maceration, from both surfaces of the leaves. After being boiled in Schulze's macerating solution, and being rinsed, they were stained by Ehrlich's haematoxylin-vesuvin double-staining. The preparations, obtained in that way, were conserved in glycerin-gelatin. Then the following epidermal characteristics were measured: relative number, index, length, width and size of stomata. The number of the cells of leaf epidermis and of stomata was counted by projecting the preparations from the microscope. Length and width of stomata were measured by an ocularmicrometer. At every preparation, 30—30 fields of sight were measured 90—90 data per specimens, 270—270 data per species. The results were valuated with a mathematico-statistical method.

The frequency-curve of the data of measurements has shown a very normal dispersion and, thus, the variancy analysis has turned out to be the most suitable for valuations (Yule-Kendall, 1957).

In the course of the significancy examinations, the validity of our conclusions from the numerical data of the examinations was controlled by F- (Fisher) and t- (student) tests.

Results

The means of the 270—270 measurement data per plant species, as well the measurement results, compared and valuated by F- and t-tests, are published in the two Tables below. The stomatal numbers are given in sq.mm, referred to the field, and the stomatal length and width in μ (Tables I, II).

Discussion

Comparing the upper and lower surface epidermis of the same species, we find a very essential difference between the numbers of the

epidermal cells and stomata. On the lower surface there are a great many stomata, every stoma being surrounded by three-four small accessory cells, and so also the number of epidermal cells is higher. Also the higher stomatal index can be explained by that. On the epidermis of the upper surface the epidermal cells are large, here are but a

Table I. Epidermal data of the upper surfaces of leaves of Solanum species.

Names of plants	Stomatal number	Stomatal index	Stomatal length	Stomatal width	St. length / St. width
S. laciniatum Ait.	43	4,5	32,73	22,57	1,319
S. aviculare Forst.	107	4,9	26,50	20,47	1,294
S. aviculare var. albiflorum Cheesem.	74	5,3	26,47	18,97	1,225
S. simile F. Muell	101	10,7	29,27	23,03	1,271
S. symonii Hj. Eich.	23	2,92	32,93	25,93	1,270
S. nigrum L.	45	10,97	36,23	25,80	1,468
S. alatum Moench.	100	16,95	33,83	19,90	1,714
S. luteum Mill.	49	10,54	36,43	24,20	1,502
S. triflorum Nutt.	160	19,83	24,77	20,00	1,237
S. boerhavii Thell.	102	21,30	34,30	23,57	1,457
S. dulcamara L.	33	3,47	24,43	19,71	1,290
S. humboldtii Willd.	-	-	-	-	-
S. chacoense Bitt.	24	6,37	28,43	21,57	1,354
S. sodomaeum L.	87	5,38	25,33	18,40	1,374
S. giganteum Jaqu.	12	0,66	25,67	19,40	1,321
F-test	84,25	352,2	50,63	49,27	49,62
LSD_5 p.c.	15,11	1,12	2,01	1,16	0,056
LSD_1 p.c.	21,98	1,64	2,93	1,70	0,82
$LSD_{0,1}$ p.c.	33,03	2,46	4,40	2,55	1,23

few stomata, if any (e.g., *Solanum humboldtii* Willd). Size and forms of the stomata on both surfaces of the leaft approximately identical, thus the stomatal size is nearly the same, as well. Comparing the epidermal values of the single species with one another, we can observe that the epidermis of the species, belonging to the same subgenus or

section are very similar to each other, as to the qualitative and quantitative epidermal features. So the stomatal size, that is characteristic of the stomatal form, is only suitable for separating the subgenera; significant differences are not always shown by the stomatal number, either.

Table II. Epidermal data of the lower surfaces of leaves of Solanum species.

Names of plante	Stomatal number	Stomatal index	Stomatal length	Stomatal width	St. length / St. width
S. laciniatum Ait.	221	14,07	33,13	23,67	1,386
S. aviculare Forst.	315	12,51	25,77	20,43	1,251
S. aviculare var. albiflorum Cheesem.	315	11,61	22,40	18,17	1,233
S. simile F. Muell	211	17,17	29,73	23,60	1,266
S. symonii Hj. Eich.	304	15,26	32,57	24,57	1,325
S. nigrum L.	189	20,75	33,33	23,67	1,449
S. alatum Moench.	209	19,54	32,53	20,50	1,708
S. luteum Mill.	201	19,24	33,63	23,27	1,426
S. triflorum Nutt.	207	18,76	26,20	19,73	1,329
S. boerhavii Thell.	168	23,00	34,67	23,40	1,480
S. dulcamara L.	287	16,21	24,33	18,53	1,303
S. humboldtii Willd.	210	14,37	25,97	18,73	1,386
S. chacoense Bitt.	219	24,74	27,37	20,80	1,316
S. sodomaeum L.	273	16,41	25,60	18,57	1,337
S. giganteum Jaqu.	279	17,10	23,63	18,73	1,260
F-test	16,44	151,19	72,02	44,94	75,75
LSD_5 p.c.	37,57	0,98	1,65	1,14	0,045
LSD_1 p.c.	54,70	1,42	2,40	1,65	0,065
$LSD_{0,1}$ p.c.	82,1	2,14	3,61	2,49	0,099

The value the most characteristic of a species is the stomatal index that shows significant differences even inside a subgenus, on a 5 p.c. level of probability. However, the stomatal index and stomatal number respond sensitively to the influences of the external environment; they cannot be considered, therefore, to be a right reliable diagnostical mark. So, if the species of *Solanum* genus are identified on the basis of the leaf epidermis, even the measurable epidermal characteristics, examined by us and considered the most stable, are giving values characteristic of a species only if applied in a complex way.

Summary

We have collected leaf samples from the middle region of shoots of the specimens of fifteen *Solanum* species grown under identical ecological conditions in a small plot. Of the middle parts of leaves epidermal preparations of maceration were made and the following quantitative epidermal values measured: relative number, index, length, width and size of stomata. The results were valued with variancy analysis.

It was ascertained that the upper and lower surface epidermis of the same species are differring considerably from each other, even in their quantitative characteristics. The greatest difference between the single species was observed concerning the value of the stomatal index while the stomatal size is a value characteristic of a certain subgenus.

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PALYNOLOGIC INVESTIGATIONS IN THE STRATA OF "BUDA MARL" WITH PLANT REMAINS

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(Received July 21, 1967)

Introduction

The stratum complex known by the name „Buda marl" has an important role in the Buda mountains, being a topic of several monographs. Petrologically it has been investigated by Sztrókay (1933), about its fossilized remains we have a lot of literary data, e.g.: about the *Mollusca* fauna on the basis of the investigations of Hofmann (1874) and Szörényi (1931), about its *Echinodermata* by the investigations of Pávay (1875) and Szörényi (1931), about its fossil macroflora by those of Rásky (1956, 1960, 1962, 1963).

From stratigraphic point of view it is classed by Hofmann (1871) in the lower oligocene, by Hantken (1874) and Ferenczi (1925) in the eocene. According to Szőts (1956) it represents the Lattorf storey corresponding, in his classification, to the upper eocene and lower oligocene. Vadász, on the other hand, came (1960) to the conclusion that a connection of the eocene with the lower part of oligocene was not practicable, even if the initial conditions of the formations in eocene and oligocene had been highly similar to one another. On the basis of his work quoted, published in 1957, the formation of „Buda marl" is joint with that of the so-called „bryozoic marl" and belongs to the eocene. Also E. Dudich, Jr. (1957) is regarding the strata mentioned above as a closing member of eocene.

A palynologic investigation of the „Buda marl" is motivated partly by problems of its geological age, but we can obtain some data, as well, from a palynologic point of view, concerning a problem treated of in a previous paper (Kedves, 1966b) — viz. the different character of the flora ensemble reconstructed bu macro- and microscopical plant remains.

Material and method

The research material has been made available for us by Dr. K. Rásky, we are experessing her our thankful gratitude for that. The samples have contained several vegetable macro — first of all leaf — remains. For preparing them, we have applied HCl treatment, separation with $ZnCl_2$, and HF after-treatment.

Results

The samples investigated may be regarded as comparatively rich in sporomorphs, but the condition of the single spores and particularly that of pollen particles is rather poor.

Note. — For determing the single spores and pollens, even some works not published till closing the manuscript have been used, denoted anyway by an asterisk for distinction.

Pteridophyta

Lycopsida

Lycopodiales, *Lycopodiaceae.* — *Camarozonosporites* cf. *avitrabilis* W. Kr. 1959b.

Pteropsida

Leptosporangiatae

Filicales, *Schizaeaceae.* — *Leiotriletes* cf. *wolffi* W. Kr. 1962d subfsp. *brevis* W. Kr. 1962d; Polypodiaceae — *Verrucatosporites histiopteroides* W. Kr. 1962a — the stratographic distribution of the latter species taking place in the lower — middle miocene; *Pterideae* — *Polypodiaceoisporites* cf. *microspeciosus* W. Kr. 1959b, *Undulozonosporites* fsp.

Gymnospermatophyta

Coniferophytina

Pinales, *Abietaceae, Pinoideae.* — *Pinus haploxylon* type *Pityosporites microalatus* (R. Pot. 1931b) Th. et Pf. 1953; *Pinus diploxylon* type — *Pityosporites labdacus* (R. Pot. 1931b) Th. et Pf. 1953.

Abietoideae v. *Laricoideae* — ? *Pseudotsuga,* ? *Larix* — *Inaperturopollenites* cf. *magnus* (R. Pot. 1934b) Th. et Pf. 1953.

Taxodiaceae. — * *Taxodiaceaepollenites granulatus* Kds. 1967.

Taxodiaceae v. *Cupressaceae. Inaperturopollenites dubius* (R. Pot. et Ven. 1934) Th. et Pf. 1953.

Ephedropsida

Ephedrales, *Ephedraceae, Ephedra.* — *Ephedripites (Ephedrivites)* cf. *wolkenbergensis* W. Kr. 1961a.

Angiospermatophyta

Dicotyledonopsida

Polycarpicae-Rubiales

Hamamelidales, *Platanaceae.* — *Tricolpopollenites retiformis* Pf. et Th. 1953.

Myrtales, *Nyssaceae v. Mastixiaceae.* — *Tricolporopollinites kruschi* (R. Pot. 1934b) Th. et Pf. 1953, *Tricolporopollenites* fsp. 1—2.

Terebinthales, Rutineae, ? *Meliaceae.* — *Tetracolporopollenites obscurus* Pf. et Th. 1953.

Sapindineae, *Anacardiaceae.* — *Tricolporopollenites dolium* (R. Pot. 1931) Th. et Pf. 1953; *Sapindaceae.* — *Cupanieidites ? nógrádensis* (Sics. 1959b) Sics. 1964.

Celastrales, *Icacinaceae.* — *Compositoipollenites rhizophorus* (R. Pot. 1934b) R. Pot. 1960.

Rhamnales, *Rhamnaceae.* — *Tricolporopollenites dorogensis* Kds. 1965b.

Cornales, *Araliaceae* v. *Cornaceae.* — *Tricolporopollenites* cf. *euphorii* (R. Pot. 1931a) Th. et Pf. 1953.

Rubiales, *Caprifoliaceae.* — *Tricolporopollenites microreticulatus* Pf. et Th. 1953f. *elongata* Pf. et Th. 1953.

Malvales-Solanales

Euphorbiales, *Euphorbiaceae.* — *Tricolporopollenites microdesmiaeformis* Kds. 1965b.

Rhoeadales-Asterales

Cistales, *Flacourtiaceae.* — *Tricolporopollenites pusztavámi* Kds. 1965b.

Caryophyllales-Monochlamydeae

Fagales, *Betulaceae, Betula.* — *Trivestibulopollenites betuloides* Pf. 1953a; *Ostrya* — *Triporopollenites rhenanus* Thoms. 1953.

Fagaceae. — *Tricolporopollenites pudicus* (R. Pot. 1934b) W. Kr. 1961d: *Tricolporopollenites* cf. *villensis* Thoms. 1953; *Tricolporopollenites* fsp. 1—3; *Tricolporopollenites fusus* (R. Pot. 1931a); *Tricolporopollenites oviformis* (R. Pot. 1931a); *Tricolporopollenites pusillus* (R. Pot. 1934a); *Tricolporopollenites pusillus* (R. Pot. 1934b); *Tricolporopollenites* cf. *porasper* Pf. 1953a.

Juglandales, *Juglandaceae.* — *Juglanspollenites maculosus* (R. Pot. 1931); *Plicatopollis* fsp.; *Carya* — *Caryapollenites simplex* (R. Pot. 1931b) Raatz, 1937 subfsp. *simplex* Th. et Pf. 1953; *Engelhardtia* — *Triatriopollenites* fsp.$_1$.

Myricales, *Myricaceae.* — *Triatriopollenites* fsp.$_{2-6}$.

Monocotyledonopsida

Spadiciflorae-Pandanales

Spadiciflorae, *Palmae, Chamaedorea.* — *Monocolpopollenites* fsp.$_1$; *Caryota, Livistona, Latania* v. *Chamaerops* — *Monocolpopollenites* fsp.$_2$; *Ptychosperma* v. *Geonoma* — *Monocolpopollenites* fsp.$_3$.

Cf. Araceae.

Besides sporomorphs, we have observed remains of *Hystrichospharidae* and those of chitin-skeletonned *Foraminiferae,* as well, in our material.

Discussion

The plant association reconstructed by the palynologic research method is doubtless an ensemble of remains without containing, of course, the representatives of all the plant groups that had lived together. A comparison of the families demonstrated on the basis of macro- and microfossils is giving a somewhat fuller picture about the former vegetation, as summarized below:

	Macrofossils	Microfossils
Rhodophyta	+	-
Pteridophyta		
Lycopodiaceae	-	+
Osmundaceae	+	-
Schizaeaceae	-	+
Hymenophyllaceae	+	-
Polypodiaceae	-	+
Gymnospermatophyta		
Abietaceae	-	+
Taxodiaceae	+	+
Cupressaceae	+	+?
Cephalotaxaceae	+	-
Ephedraceae	-	+
Angiospermatophyta		
Dicotyledonopsida		
Lauraceae	+	-
Platanaceae	-	+
Mimosaceae	+	-
Rhizophoraceae	+	-
Nyssaceae v. Mastixiaceae	-	+
Combretaceae	+	-
Simaroubaceae	+	-
Meliaceae	-	+?
Malpighiaceae	+	-

	Macrofossils	Microfossils
Anacardiaceae	+	+
Sapindaceae	-	+
Icacinaceae	-	+
Rhamnaceae	-	+
Araliaceae v. Cornaceae	-	+
Caprifoliaceae	+	+
Tiliaceae	+	-
Malvaceae	+	-
Sterculiaceae	+	-
Elaeocarpaceae	+	-
Euphorbiaceae	+	+
Flacourtiaceae	+	+
Passifloraceae	+	-
Actinidaceae	+	-
Proteaceae	+	-
Urticaceae	+	-
Betulaceae	+	+
Fagaceae	+	+
Juglandaceae	+	+
Myricaceae	-	+
Monocotyledonopsida		
Palmae	+	+
Cf. Araceae	-	+

The macroremains demonstrated on the basis of Rásky's investigations represent 27 families two of which belong to the Pteridophyta, three to the *Gymnospermatophyta,* and 22 to the *Angiospermatophyta,* apart from the *Rodophyta* fossils.

Our microscopic remains are referring to 24 families. (3 *Pteridophyta,* 4 *Gymnospermatophyta,* 17 *Angiospermatophyta).*

From *Pteridophyta* there is not one single corresponding family. The macrofossils belong to the *Osmundaceae* and *Hymenophyllaceae,* the microfossils to the *Lycopodiaceae, Schizaeaceae* and *Polypodiaceae* families. The absence of the macrofossils of *Schizaeaceae* is obvious as their spores are very common in the paleogeneous deposits in this country (cf. *Lygodium, Anemia).*

From the *Gymnospermatophyta,* the *Taxodiaceae* and *Cupressaceae* are equally known on the basis of the macro- and microfossils. The macrofossils of the *Abietaceae* family are not known from the Buda marl, as yet, their pollen is, however, rather frequent. These species must have lived in areas far from the seaside and their pollen, carried easily along by the wind, could be whirled by it into the sea. Also the specks of pollen of the *Ephedra* genus may have been carried by the wind into the sediment-reservoir, as this plant family of xerophilous character must have lived farther from the site of its embedding, and the vegetative organs of the plant have but a little probability of being fossilized.

From the *Angiospermatophyta,* the *Fagaceae, Juglandaceae, Flacourtiaceae,* and *Palmae,* that are staminate plants, as well the *Anacardiaceae, Euphorbiaceae,* and *Caprifoliaceae,* are represented by macro- and microfossils. Besides the relatively high number of the pollens of the *Nyssaceae* and *Myricaceae,* the absence of their macrofossils is the more obvious because the species of both families may have lived in the association of the swampy wood of the moorland. In addition to the pollens of the *Platanaceae,* ? *Meliaceae, Araliaceae* v. *Cornaceae* and cf. *Araceae,* we mention also the absence of their macro-remains.

From the *Lauraceae* family, the leaf-remains of the *Cinnamonum* family could be found. The problem of the fossilization of their pollens is generally known, they can be destroyed extremely easily. We could not find, as yet, any pollen of *Mimosaceae, Rhizophoraceae, Combretaceae, Simaroubaceae, Malpighiaceae, Tiliaceae, Malvaceae, Sterculiaceae, Elaeocarpaceae, Passifloraceae, Actinidaceae, Proteaceae* and *Urticaceae* families, in addition to their macroremains. We mention that the pollens of a great part of the families enumerated may be recognized relatively easily *(Mimosaceae, Rhizophoraceae, Tiliaceae, Elaecarpaceae, Passifloraceae),* particularly the absence of the *Tiliaceae* and *Rhizophoraceae* pollens is obvious.

The remains of the *Hystrichosphaeridae* and of the chitin-skeletonned *Foraminiferae* are referring to a maritime origin of the samples investigated.

From the point of view of stratigraphy, the following sporomorphs are of significance:

a) Those not known from the eocene in Hungary, as yet:
Leiotriletes cf. *wolffi* subfsp. *brevis*
Verrucatosporites histiopteroides
* *Taxodiaceaepollenites granulatus*
Ephedripites (Ephedripites) cf. *wolkenbergensis*
Trivestibulopollenites betuloides
Caryapollenites simplex subfsp. *simplex*
Juglanspollenites maculosus

b) The pollens occuring commonly in the tertiary period, being frequent first of all from the upper eocene;
Pityosporites microalatus f. *minor*
Pityosporites labdacus

Considering the high number of the sporomorphs from the „younger tertiary period", the samples investigated cannot be older than the oligocene.

In comparison with the spore-pollen composition recognized, so far, from the bryozic marl, we may conclude that the Buda marl must be more recent formation and thus the chronological separation of the marl formations of the Buda mountains is reasonable.

Summary

1. Palynologic investigations have been carried out on samples of the stratum of Buda marl containing plant remains. The spore-pollen investigations demonstrate the occurence of the families *Lycopodiaceae, Schizaeaceae, Polypodiaceae, Abietaceae, Taxodiaceae,* ? *Cupressaceae, Ephedraceae, Platanaceae, Nyssaceae* v. *Mastixiaceae,* ? *Meliaceae, Anacardiaceae, Sapindaceae, Icacinaceae, Rhamnaceae, Araliaceae* v. *Cornaceae, Caprifoliaceae, Euphorbiaceae, Flacourtiaceae, Betulaceae, Fagaceae, Juglandaceae, Myricaceae, Palmae* and cf. *Araceae.*

2. On the basis of the spore-pollen composition, the age of the samples investigated is oligocene.

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A PROPOS DES RÉGIONS PALÉOPHYTOGÉOGRAPHIQUES DU CRÉTACÉ ET DU PALÉOGENE, D'APRES LES DONNÉES PALYNOLOGIQUES I.

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L'étude intensive des associations sporo-polliniques du Crétacé supérieur et du Tertiaire inférieur surtout celle des sédiments de l'Hemisphère Nord, ont permis d'envisager des synthèses générales. Ainsi Krutzsch (1960), Zaklinskaia (1962, 1963, 1966, 1967), puis Krutzsch, 1967 (in Góczán, Groot, Krutzsch et Pacltová, 1967) en se basant sur la répartion géographique des pollens d'*Angiospermes* de type ancien ont distingué plusieurs régions paléophytogéographiques. Selon les premières hypothèses ont peut distinguer deux grandes régions dans l'Hemisphère Nord caractérisées, l'une par la présence des Normapolles, l'autre par les espèces du genre de forme *Aquilapollenites*. En Eurasie la limite suit la chaîne des Monts Oural, elle coupe grosso modo l'Amérique du Nord en deux. En Asie vers le Sud de la zone des *Aquilapollenites* la présence des *Proteaceae* et des *Olacaceae* est caractéristique, et, pour la partie ouest de l'Amérique du Nord celle des *Proteaceae* et des *Ulmaceae*. En ce qui concerne les divisions plus fines, on a distingué des provinces (par exemple: Tourkmeno-Kazakhstan) et des sous-provinces (par exemple: Sachalin) supplémentaires. Plus tard Zaklinskaia (1966) en Amérique du Nord n'a pas établi de limite stricte entre les deux régions. Krutzsch enfin (1967) a émis une idée nouvelle: en Eurasie et en Amérique du Nord il y a des provinces identiques, notamment entre les provinces caractérisées par les *Normapolles* et par les *Aquilapollenites* il y a une province dite intermédiaire.

Le problème que nous venons d'évoquer est né de l'étude de l'extension stratigraphique des différents types de sporomorphes. Il y a dix ans Krutzsch (1958) avait synthétisé dans un tableau stratigraphique les principaux types de sporomorphes d'Europe Centrale. Le problème de la "méthode des types" pour la solution des problèmes stratigraphiques des sédiments du Crétacé supérieur et du Paléogène, particulièrement pour établir un parallèle entre des sédiments contemporains de régions éloignéese, sédimentés dans des conditions différentes a été

soulevé ultérieurement (K e d v e s, 1967). Il nous a semblé souhaitable de souligner encore une fois les faits suivants:

Parmi les différentes études de spores et pollens fossiles il faut distinguer nettement les études qui ont pour but la détermination de l'âge des sédiments de celles qui ont pour but des corrélations locales.

L'une est du ressort de la palynologie phylogénétique puisque c'est la succession des formes fossiles dans le temps qui permet de préciser l'âge, l'autre s'attache à l'étude de la zonation de la végétation fossile, elle est essentiellement de la paléoécologie. En déterminant l'âge des sédiments il nous faut donc préciser le degré phylogénétique de la flore fossile au moyen de la palynologie. Au cours de ce travail certains sporomorphes étudiés (espèces, types ou groupes) se sont révélés, bien qu'ils soient peu abondants, et parfois rares, d'une importance primordiale.

Nous supposons que le rythme de la phylogénèse, en tout cas dans l'Hemisphère Nord, et probablement dans le monde entier, a été approximativement identique, ainsi nous semble-t-il possible d'établir un parallèle entre des complexes sporo-polliniques de régions éloignées les unes des autres. Il nous faut souligner ici que des associations de flores fossiles qui se sont établies sous des conditions climatiques et écologiques différentes peuvent avoir le même "degré" phylogénétique durant la même période. Naturellement des flores contemporaines, de même "degré" phylogénétique et établies dans des régions différentes peuvent avoir des espèces et genres différents, ainsi dans des ensembles sporo-polliniques nous pouvons observes des "espèces" ou des taxons supérieurs différents. Par exemple en ce qui concerne l'Europe, à l'intérieur d'une même province paléophytogéographique, la méthode des types de sporomorphes a été la seule possible pour établir des corrélations entre des régions lointaines d'après les données palynologiques. Le problème est plus difficile si nous essayons d'appliquer ces parallelismes à des régions paléophytogéographiques différentes. Pour un travail initial l'Amérique du Nord, à l'exception du Canada qui soulève immédiatement le probleme des relations palynologiques entre la Siberie orientale et l'Amérique du Nord, nous a semblé la plus appropriée. Notre travail est destiné à établir des rapports généraux du point de vue nouveau des complexes sporo-polliniques du Crétacé supérieur et du Paléogène et doit être effectué en plusieurs étapes. Le but de ce travail est récapitulé ci-dessous:

1. Composer d'après les données bibliographiques le tableau stratigraphique des principaux types de spores et pollens du Crétacé (en premier lieu du Crétacé supérieur) et du Paléogène et le comparer avec les autres tableaux établis de façon semblable pour l'Europe.
2. Interpréter le problème des régions paléophytogéographiques de l'Amérique du Nord en tenant compte des données nouvelles.

Il est clair qu'il est assez difficile de donner un ordre chronologique à des complexes sporo-polliniques de régions paléophytogéographiques différentes d'après les données bibliographiques, surtout si nous tenons compte de ce que, dans plusieurs cas, la détermination de l'âge des sédiments effectuée avec des méthodes paléontologiques différentes a donné des résultats différents. Il est donc probable que l'ordre chrono-

logique de notre tableau subira des modifications ultérieures. Mais malgré les risques d'erreurs nous pensons que notre travail donnera une impulsion nouvelle aux recherches, également en Europe.

Nous avons préparé notre tableau selon la méthode exposée dans un travail précédent (Kedves, 1967) et utilisé les travaux de Wodehouse (1933), Wilson et Webster (1946), Traverse (1955), Anderson (1960), J. Gray (1960), Krutzsch (1960), J. Groot, Penny et C. Groot (1961), J. Groot et C. Groot (1962), Jones (1962), Norton et Hall (1962), Engelhardt (1964) Elsik (1965), Stanley (1965), Th. Gray et J. Groot (1966), Drugg (1967). Il concerne trois provinces paléophytogéographiques différentes. Ainsi les complexes polliniques contemporains, mais de régions et de conditions écologiques générales différentes, ont-ils placés côte à côte; il s'agit donc d'un essai préliminaire pour établir des rapports entre les associations sporo-polliniques de degré phylogénétique comparable mais provenant de régions paléophytogéographiques différentes. Nous récapitulons ci-dessous les remarques essentielles qui découlent de notre tableau:

I. Types de sporomorphes ayant approximativement la même valeur stratigraphique en Amérique du Nord et en Europe.

1. *Turonipollis* fspp.
2. *Quedlinburgipollis* fspp.
3. *Sporopollis* fspp.
4. *Latipollis* fspp.
5. *Extratriporopollenites* fspp.
6. *Triporopollenites robustus* (connu dans les provinces des *Proteaceae, Aquilapollenites* et *Normapolles* et ayant à peu près la même valeur stratigraphique).
7. Formes adriennoides
8. *Cicatricosisporites* fssp.
9. *Nudopollis* fssp.
10. *Anacolosidites* fssp.
11. *Alangiopollis barghoornianum*
12. Formes fagoides
13. *Liquidambarpollenites* fssp.
14. *Graminidites* fssp.
15. Groupe incertus
16. *Corsinipollenites* fssp. (pollens des *Onagraceae).*

II. Distinction, par les associations sporopolliniques, de la province des Normapolles de l'Amérique du Nord et de l'Europe.

1) Types de sporomorphes caractéristiques des sédiments du Crétacé supérieur et du Paléocène d'Europe qui ne sont pas connus jusqu'ici en Amérique du Nord.

1. *Interporopollenites* fspp.
2. *Oculopollis* fspp.

3. *Basopollis* fspp.
4. *Papillopollis* fspp.

2) Types de sporomorphes des sédiments paléocènes d'Europe qui, jusqu'ici, ne sont pas connus en Amérique du Nord.

1. *Stephanoporopollenites* fspp.
2. Groupe pseudoalnoide
3. Groupe validus
4. Groupe supplingensis (= *Interpollis* fspp.)

3) Types de sporomorphes du Paléocène et de l'Eocène d'Europe qui ne sont pas connus en Amérique du Nord; ils sont relativement abondants et remarquablement variés.

1. *Pentapollenites* fspp. (n'est pas connu avec certitude en Amérique du Nord).
2. L'absence, ou la présence sporadique des pollens "caryoides de type ancien" en Amérique du Nord (par exemple: groupe constans, anulatus, magnoporatus, etc.).
3. Les pollens du genre de forme *Plicatopollis* et du "type platycaryoide", abondants dans les couches paléocènes et éocenès d'Europe, sont extrêment rares en Amérique du Nord.
4. Les pollens du "type cingulum" (= formes quisqualoides) abondants dans les sédiments paléogènes d'Europe, sont relativement rares en Amérique du Nord.
5. La présence de pollens de palmiers dans certaines associations sporo-polliniques de l'Eocène d'Europe n'a pas été rencontrée en Amérique du Nord.
6. Les pollens des *Taxodiaceae-Cupressaceae* sont relativement moins abondants en Amérique du Nord qu'en Europe.

III. Comme autre différence mentionnons l'absence des pollens du genre *Alnus* dans des sédiments oligocènes de Brandon.

IV. Types de sporomorphes identiques en Europe et en Amérique du Nord mais de valeur stratigraphique différente:

A) Dans la province des *Normapolles* de l'Amérique du Nord:
1. Les pollens du genre de forme Vacoupollis se rencontrent jusqu'à la partie inférieure du Crétacé supérieur, en Europe jusqu'au sommet de l'Eocène inférieur.
2. Les pollens du genre de forme *Plicapollis* se rencontrent jusqu'à la partie inférieure du Crétacé supérieur, en Europe jusqu'à l'Oligocène inférieur.

B) Dans la province des *Proteacidites* de l'Amérique du Nord:
1. Les "formes juglandoides" se rencontrent à partir de l'étage Meastrichtien, en Europe à partir de l'Oligocène inférieur.

2. Les "formes ulmoides et iliacoides" se rencontrent à partir du Danien, en Europe à partir du Paléocène.
3. Les pollens du genre de forme *Bombacacidites* se rencontrent à partir du Danien, en Europe à partir de l'Eocène.

C) Dans la province des Aquilapollenites de l'Amérique du Nord:
1. Les "formes platycaryoides" se rencontrent à partir du Maestrichtien, en Europe on les trouve en général à partir de l'Eocène moyen.
2. Les "formes piceoides" se rencontrent à partir du Paléocène supérieur, en Europe à partir de l'Eocène moyen.
3. Les pollens du genre de forme *Thomsonipollis* se rencontrent dans des sédiments du Maestrichtien. Ce genre de forme a, dans la province des Normapolles d'Amérique du Nord, une valeur stratigraphique identique à celle qu'il a en Europe (Eocène inférieur).
4. Les pollens du genre de forme Classopollis ont été trouvés des sédiments paléocènes, il est probable que c'est à la suite d'un remaniement.

D) En Amérique du Nord dans les provinces des *Proteacidites* et des *Aquilapollenites* les pollens du genre de forme *Erdtmanipollis* sont connus au *Maestrichtien* (Type *Pachysandra).* Ici il y a lieu de remarquer que Gray et Sohma (1964) ont publié cette forme provenant de localités d'âge crétacé, paléocène, éocène, oligocène et miocène. Krutzsch (1962) (1962) l'a signalée dans les sédiments de Lausitz (Oligocène, Chattien supérieur).

V. Types de sporomorphes d'Amérique du Nord inconnus en Europe jusqu'à présent:
1. *Trialapollis* fgen.
2. *Anacolosidites rotundus*
3. *Triporopollenites* fspp. groupe *marcaensis* (cf. Drugg, 1967) semble être un type bien caractéristique de la province des *Proteacidites* d'Amérique du Nord.
4. *Rectosulcites latus.*

La répartition géographique de quelques types de sporomorphes a été représentée par une carte où l'on a essayé de donner les limites plus ou moins précises des différentes provinces. Nous faisons à ce sujet, les remarques suivantes:

I. Province des Proteacidites

D'après les travaux d'Anderson (1960) et de Drugg (1967) nous possédons des données sporo-polliniques sur les sédiments du Danien et du Paléocène. L'abondance des espèces de forme du genre *Proteacidites* est caractéristique, mais il faut souligner aussi l'importance des pollens du genre de forme *Liliacidites*. La présence du *Triporopollenites marcaensis* et celle du *Triporopollenites andersonii* décrits par Drugg (1967) sont également importantes. Parmi les *Normapolles* les genres de forme *Nudopollis, Trudopollis* et *Extratriporopollinites* sont représentés. Il est intéressant de constater que les espèces du genre de forme *Gothanipollis décrites* par Drugg (1967) se distinguent nettement des types d'Europe, mais encore des types d'Amérique du Nord décrits par Engelhardt (1964). La quantité remarquable des "formes ulmoides" est connue seulement dans les complexes sporo-polliniques de New-Mexico, fait curieux puisque, selon les données bibliographiques ces pollens sont considérés, dans cette province, comme associés aux pollens des *Proteaceae*. Au même endroit mentionnons, comme phénomène local, l'abondance remarquable de *Rectosulcites latus* dont il n'est pas exclu que l'on puisse démontrer ultérieurement l'importance au niveau de la région.

II. Province des Aquilapollenites

En ce qui concerne le genre de forme *Aquilapollinites* d'Amérique du Nord nous avons des documents bibliographiques abondants (Funkhouser, 1961; Stanley, 1961; Norton, 1965), mais jusqu'ici des associations polliniques complètes n'ont été publiées que sur peu de localité seulement. Selon nos connaissances actuelles il semble que l'on puisse parler de province des *Aquilapollenites* sensu strictu et sensu lato. Pour la province des *Aquilapollenites* sensu strictu nous avons les association sporo-polliniques du Dakota (Stanley, 1965) et du Montana (Norton et Hall, 1967). A côté du genre de forme d'*Aquilapollenites* les espèces du genre *Wodehouseia, Trialapollis scabratus, Aenigmapollis polyformis, Anacolosidites rotundus* et *Pterocarya* levis décrits par Stanley (1965) sont importants. (Les pollens publiés sur la planche 45, fig. 19, 20, 22, 23 appartiennent probablement à un genre nouveau qu'il faudra décrire). Le genre de forme *Proteacidites* est représenté dans cette province également, les genres des *Normapolles* sont absents (sauf le genre *Thomsonipollis*).

Sensu lato l'association pollinique de l'Arkansas publiée par Jones (1962) peut appartenir à cette province. Il nous faut noter ici qu'il nous a semblé, d'après les données bibliographiques, que l'extension stratigraphique des pollens de ce genre de forme est assez limitée, principalement au Maestrichtien. C'est pourquoi la présence de ce genre de forme dans des sédiments paléocènes de l'Arkansas peut aussi nous faire penser à un remainiement. Cette idée est étayée par la présence de la même association sporo-pollinique du genre de forme *Classopollis*. Malgré cette possibilité il faut tenir compte de la présence des pollens

D'APRES LES DONNEES BIBLIOGRAPHIQUES FAITES EN NOVEMBRE 1967

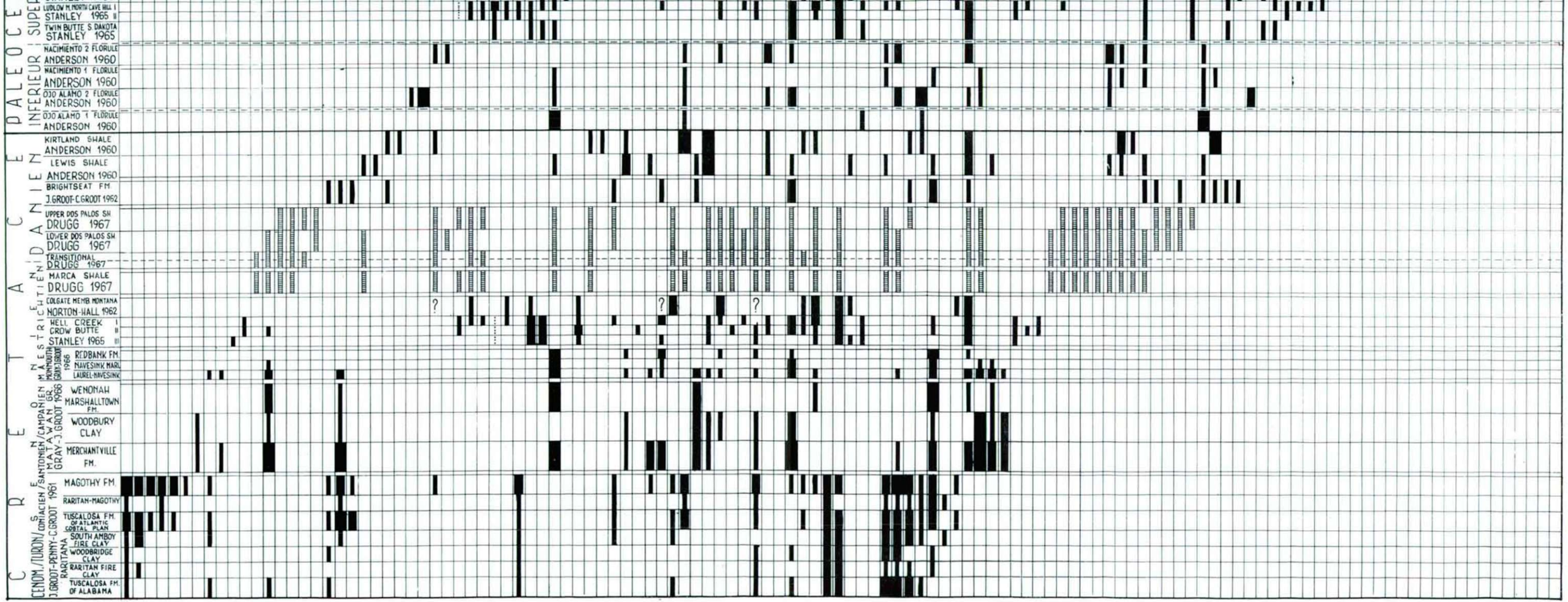
LEGENDE

très fréquent ou dominant
fréquent
disséminé
présence inconnue
? présence douteuse

GROUPE ORBICULATUS
GROUPE INAEQUALIS
PETITES FORMES TRIPOREES avec anuli
TURONIPOLLIS FSPP.
VACUOPOLLIS FSPP.
QUEDLINBURGIPOLLIS FSP.
PFLUGIPOLLENITES DAMPIERI
ARAUCARIACITES FSP.
ROTASPORA RUGULATUS
TRIALADPOLLIS SCABRATUS
ANACOLOSIDITES ROTUNDUS
UNDULATISPORITES FSPP.
APPENDICISPORITES FSPP.
TRIPOROPOLL.FSPP GROUPE MARCAENSIS
TAUROCUSPISPORITES FSPP.
DIPORITES FSPP.
KLUKISPORITES FSP.
LATIPOLLIS FSPP.
PLICAPOLLIS FSPP.
SPOROPOLLIS FSPP.
GROUPE ECHINATISPORIS
EUCOMMIIDITES COUPERI
EXTRATRIPOROPOLLENITES FSPP.
MONOSULCITES PERPINOSUS
TRICHOTOMOSULCITES FSP.
RECTOSULCITES LATUS
GROUPE LYCOSPODIUMSPORITES
BOMBACACIDITES FSPP.
ERDMANIPOLLIS FSPP.
GROUPE OSMUNDACIDITES
GROUPE FOVEOTRILETES
STEREISPORITES (DISTANCORAESPORIS) FSPP.
TRIPLANOSPORITES FSPP.
TOROISPORIS (TOROISPORIS) FSPP.
WODEHOUSEIA FSPP.
RETICULATAESPORITES + SCHIZOSPORIS FSPP.
FORMES PODOCARPOIDES
FORMES FRAXINOIDES
AQUILAPOLLENITES FSPP
POLYPODIACEOISPORITES FSPP.
CLASSOPOLLIS FSPP.
TYPE TRIPOROPOLLENITES ROBUSTUS
LEIOTRILETES FSPP. GROUPE PERCRASSUS
THOMSONIPOLLIS FSPP.
TRUDOPOLLIS FSPP.
CAMAROZONOSPORITES SUBFGEN. ET FSPP.
CYATHIDITES FSPP.
LILACIDITES
TRIATRIOPOLL.FSPP. GROUPE RURENSIS/BITUITUS
PROTEACIDITES FSPP.
GROUPE GLEICHENIIDITES
LEPTOLEPIDITES FSPP.
MICROFOVEOLATOSPORIS FSPP.
CICATRICOSISPORITES FSPP.
CUPANIEIDITES FSPP
SCHIZAEOISPORITES FSPP.
GROUPE ADRIENNIS
FORMES CYCADACEOIDES
STEREISPOR.SUBFGEN ET FSPP.EXC. DISTANCORAESP.
GROUPE DUBIUS
GROUPE HIATUS
EPHEDRIPITES SUBFGEN. ET FSPP.
FORMES ALNOIDES
FORMES SAPOTACEOIDES
GROUPE MICROMUNUS, PARVULUS ETC.
FORMES SALICACEOIDES
GROUPE CINGULUM
GROUPE HENRICI
GROUPE PINUS DIPLOXYLON
FORMES TSUGOIDES
GROUPE POLYFORMOSUS
LAEVIGATOSPORITES FSPP.
FORMES NYSSOIDES
FORMES EXACTOIDES
FORMES VESTIBULOIDES
GROUPE RHOIPITES
FORMES PTEROCARYOIDES
"TRICOLPOROPOLL. FSPP STRIEE"
VERRUCATOSPORITES FSPP.
GROUPE SATZVEYENSIS
DUPLOPOLLIS FSPP
GOTHANIPOLLIS FSPP.
GROUPE MYRICIPITES
GROUPE MOMIPITES
POLLENS DES PALMIERS ± LISSES
FORMES JUGLANDOIDES
GROUPE "PINUS HAPLOXYLON
INUDOPOLLIS FSPP
GROUPE INCERTUS
FORMES ILIACOIDES
TETRADES
GROUPE ULMOIDES
FORMES TILIOIDES
FORMES ENGELHARDTOIDES
FORMES CARYOIDES
GROUPE BREVITRICOLPITES
TYPE MYRIOPHYLLUM
FORMES PICEOIDES
TYPE VITIS
FORMES BETULOIDES
FORMES CORYLOIDES
FORMES CARPINOIDES
GROUPE SABALPOLLENITES
PLICATOPOLLIS FSP.
POLYPOROPOLLENITES FSP.
NOTHOFAGIDITES FSP.
POLYCOLPOROPOLLENITES FSP.
ANACOLOSIDITES FSPP.
FORMES PLATYCARYOIDES
"TRICOLPOROPOLL. FSPP. VERRUQUEUSE"
RETICULAEPOLLIS FSP
TRICOLPITES THOMASII
CORSINIPOLLENITES FSPP.
TIPE LIRIODENDRON
GRAMINIDITES FSPP.
LIQUIDAMBARPOLLENITES FSPP.
TYPE MORUS
TYPE TYPHA
SMILACIPITES FSPP.
CAPRIFOLIPITES FSPP.
FORMES FAGOIDES
ALANGIOPOLLIS BARGHOORNIANUM

EOCENE
OLIGOCENE
WILCOXIEN (CLAYBORNIEN) JACKSONIEN

BRANDON LIGNITE TRAVERSE 1955
GREEN RIVER FM. WODEHOUSE 1933
FORT UNION MONTANA WILSON-WEBSTER 1946
ALABAMA GRAY 1960
COCKFIELD FM. ENGELHARDT 1964
SALINE FM. ARKANSAS JONES 1962
AUSTIN /TEXAS/ KRUTZSCH 1960
MILAM, ROBERSTON /TEXAS/ ELSIK 1965
PORTERS CREEK ARKANSAS JONES 1962


PALEOCEEN
INFERIEUR / SUPERIEUR
LUDLOW M. NORTH CAVE HILL I
STANLEY 1965 II
TWIN BUTTE S. DAKOTA
STANLEY 1965
NACIMIENTO 2 FLORULE
ANDERSON 1960
NACIMIENTO 1 FLORULE
ANDERSON 1960
OJO ALAMO 2 FLORULE
ANDERSON 1960
OJO ALAMO 1 FLORULE
ANDERSON 1960
KIRTLAND SHALE
ANDERSON 1960
LEWIS SHALE
ANDERSON 1960
BRIGHTSEAT FM.
J. GROOT-C. GROOT 1962
UPPER DOS PALOS SH.
DRUGG 1967
LOWER DOS PALOS SH.
DRUGG 1967
TRANSITIONAL
DRUGG 1967
MARCA SHALE
DRUGG 1967
COLGATE MEMB. MONTANA
NORTON-HALL 1962
WELL CREEK I
GROW BUTTE II
STANLEY 1965 III
MONMOUTH GRP. J. GROOT 1966
REDBANK FM.
NAVESINK MARL
LAUREL-NAVESINK
WENONAH MARSHALLTOWN FM.
WOODBURY CLAY
MERCHANTVILLE FM.
MATAWAN GR. GRAY-J. GROOT 1966
MAGOTHY FM.
RARITAN-MAGOTHY
TUSCALOSA FM. OF ATLANTIC COASTAL PLAIN
SOUTH AMBOY FIRE CLAY
WOODBRIDGE CLAY
RARITAN FIRE CLAY
TUSCALOSA FM. OF ALABAMA
RARITANA J. GROOT-PENNY-C. GROOT 1961
CENOM./TURON/S. CONIACIEN / SANTONIEN / CAMPANIEN
CRETACEE
NEERICHTIEN
MAESTRICHTIEN
DANIEN

du genre de forme *Aquilapollenites* de cette localité. Naturellement la solution de ce problème ne peut être le but de notre travail, nous essayons simplement d'interpréter les faits publiés. Ainsi remarquerons nous l'absence des pollens du genre de forme *Wodehouseia,* et la présence du genre de forme *Trudopollis* des *Normapolles* de ce complexe sporo-pollinique. Nous ne négligerons pas non plus la présence des "formes ulmoïdes" étant donné qu'il s'agit d'un complexe paléocène.

III. Province des Normapolles

Nous nous sommes occupés des associations sporo-polliniques du Crétacé inférieur et de la partie inférieure du Crétacé supérieur d'une manière accessoire, ce qui explique que plusieurs travaux précieux n'aient pas été utilisés pour notre tableau. Nous commencerons l'interprétation de ces complexes en parlant de la formation de Brightseat qui a été étudiée par J. Groot et C. Groot (1962) et rangée dans le Danien. Malheureusement comme l'ont remarqué les auteurs les échantillons étudiés n'étaient pas riches en sporomorphes. Malgré cela plusieurs genres de forme des Normapolles ont été mis en évidence *(Plicapollis, Extratriporopollenites, Latipollis).* Les "formes ulmoïdes" sont présentes, les pollens du genre de forme *Proteacidites* et *Liliacidites* n'ont pas été observés.

Il est regrettable que des complexes sporo-polliniques du Paléocène de cette province n'aient pas encore été trouvés en Amérique du Nord. Leur mise en évidence permettait de résoudre plusieurs problèmes, tout spécialement celui du genre de forme Stephanoporopollenites. Comme il ressort de plusieurs publications, les pollens de ce genre de forme en Europe sont les "marqueurs" des sédiments paléocènes et n'ont pas encore été trouvés en Amérique du Nord. On peut supposer soit que ces pollens aient une importance régionale, leur présence étant limitée a l'Europe, soit que leur répartition géographique s'étende à la région entière des *Normapolles* mais qu'ils n'aient pas encore été découverts en Amérique du Nord. Leur absence dans des couches paléocènes de l'Amerique du Nord. permettrait de séparer strictement les provinces à *Normapolles* d'Europe de celle d'Amérique du Nord, ce que d'autres documents permettent de supposer.

Les associations sporo-polliniques éocènes de l'Amérique du Nord contiennent des types relativement plus modernes que celles d'Europe. Nous mentionnons encore une fois l'absence de quelques genres de forme des Normapolles, et l'abondance restreinte par rapport à l'Europe des pollens du genre de forme *Plicapollis* et des pollens "caryoides" de type ancien. En ce qui concerne les *Normapolles* l'absence des genres de forme *Interpollis, Basopollis, Pompeckjoidaepollenites* et *Vacuopollis* est important.

L'absence, dans les sédiments de l'Eocène moyen d'Amérique du Nord, de *Pentapollenites* est étrange car en Europe les pollens de ce genre de forme sont très abondants dans les couches de cet étage.

Les associations sporo-polliniques de l'Eocène supérieur et de l'Oligocène d'Europe et d'Amérique du Nord ont des caractères distincts, mais

il faut noter l'apparition de plusieurs types polliniques dits modernes qui sont voisins ou identiques.

En résumant nous pouvons constater qu'il est possible d'établir un parallèle entre des associations sporo-polliniques de régions éloignées par la méthode des types. En Amérique du Nord dans des provinces paléophytogéographiques différentes quelques types de pollens peuvent avoir des valeurs stratigraphiques différentes. Dans certains cas quelques types ont la même valeur stratigraphique en Amérique qu'en Europe, mais cette valeur permet toutefois de distinguer plusieurs régions paléophytogéographyques en Amérique du Nord même.

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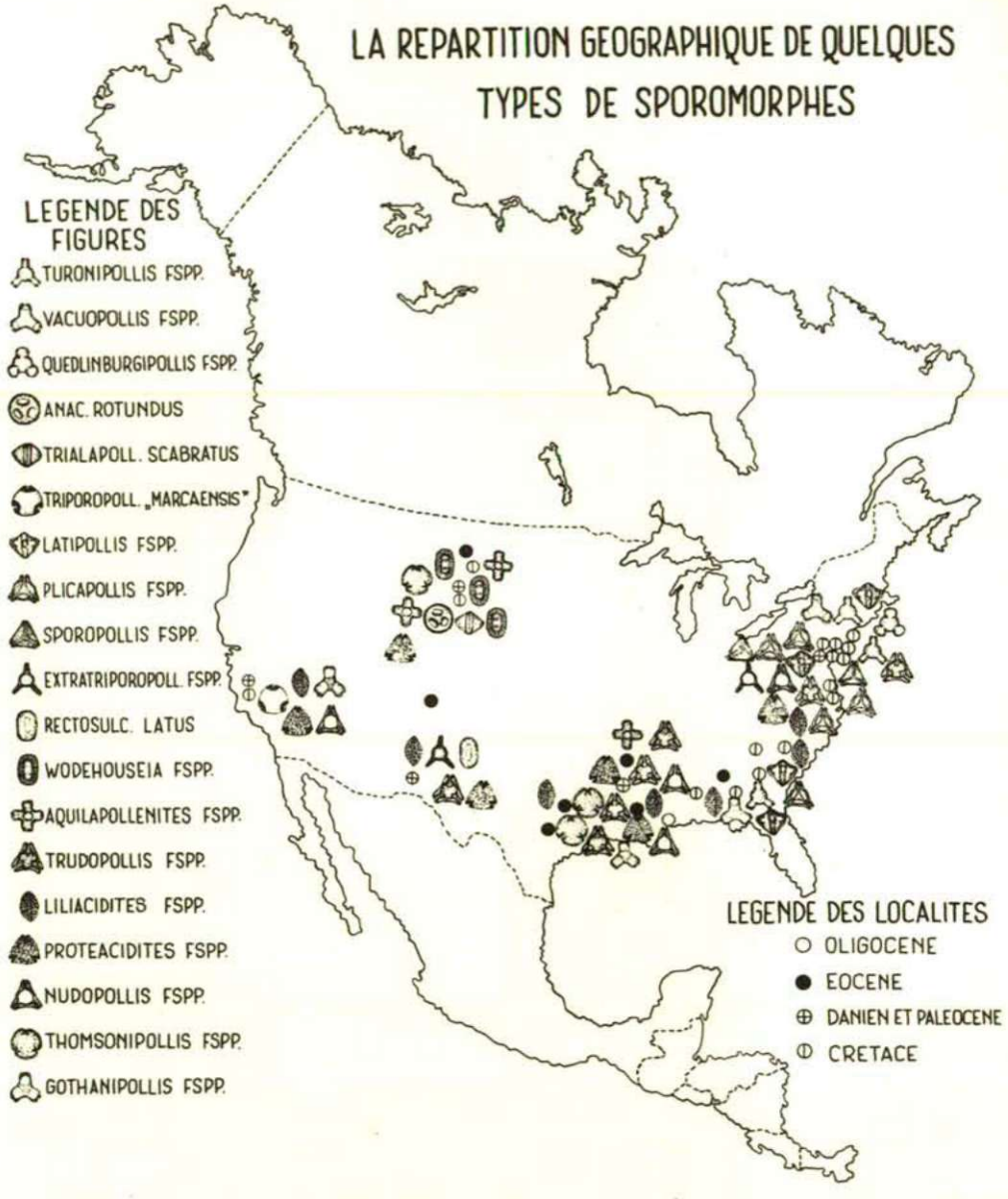
LA REPARTITION GEOGRAPHIQUE DE QUELQUES TYPES DE SPOROMORPHES



STUDIES ON THE LIGHT SENSITIVITY OF PLANTAGO MAJOR L. SEEDS III. THE EFFECT OF LIGHT COLOUR AND INTENSITY

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Introduction

It has been noticed that Plantago major seeds are light-sensitive and that increasing the quantity of light delivered to the seeds increases their percentage of germination (Tadros and Rezk, II, 1966). This was confirmed by an experiment to test the effect of the depth of sowing on the germinability of those seeds, the results of wich showed that decreasing the depth at which the seeds were sown increased the degree of emergence of the seedlings. On the other hand, the different colours of light are known to affect the germination especially that of light-sensitive seeds.

In this paper a trial is made to elucidate the effect of prolonged exposure of the germinating seeds of P. major to red, blue, and white light at different intensities.

It is a well known fact that red light stimulates the germination of light-sensitive seeds (e.g. *Lactuca sativa* seeds) although for the seeds of *Plantago major* it was shown that this colour had no promoting effect on their germination in the dark (Rezk II, 1968).

Evenari et al (1957) using three types of monochromatic light sources have reported that the three types of blue light showed identical behaviour in that they inhibited the germination in the first few hours before promoting it after 10 hours of imbibition. Blue light is also reported to have a retarding effect on seed germination and it even simulates far-red light in nullifying the promoting effect of red light on the germination of *Lactuca sativa seeds* (Wareing and Black, 1958; Black and Wareing, 1960).

Materials and Methods

Three incubators were equipped with fluorescent lamps to deliver white, red, and blue light. The highest light intensity was 10 000 erg (cm^2) sec, and lower light intensities were obtained by putting layers of white translucent paper on the Petri-dishes themselves or on the basins containing them. These added layers were examined and proved to act as neutral filters. The technique used for preparing the Petri-dishes is exactly the same as that described before (Rezk II, 1968). The seeds received light of the desired colour and intensity for 10 hours daily inside the incubators. Four light intensities were obtained: 10 000, 7000, 3000, and 200 erg (cm^2) sec. For each light intensity in each colour 200 seeds were used distributed into four Petri-dishes. The whole was 48 Petri-dishes containing a sum of 2400 seeds. The seeds were of 1967 crop.

After 15 days the basins were opened and the germination percentages calculated. It was intended not to count the germinating seeds daily in order not to expose the seeds to different light intensities that may disturb the light regime to which the seeds were exposed.

Results and Discussion

The results are graphically illustrated in Fig. 1. It is clear from this figure that increasing the intensity of any colour of light resulted in the increase of the germination percentage of *Plantago major* seeds.

The germination percentage at the red light occupied always the highest position at all intensities. The behaviour is in concordance with the findings of other authors working upon the germination of light-sensitive seeds.

White light gave results that were intermediate between those of the red and the blue except at the highest intensity of 10 000 erg (cm^2) sec where it resulted in the lowest germination percentage at that intensity. This peculiar behaviour was suspected to be an experimental error and so the exposure to the three light colours at this high intensity was repeated twice and was found consistent. To explain such a result it may be said that this is a sort of inhibition of germination at such a high intensity of white light. Similar effects of high doses of white light have been previously observed by Mittal and Mathur (1965) on tomato seeds. These authors mentioned that continuous irradiation of tomato seeds resulted in poor germination while the reduction of the amount of white light delivered to the seeds resulted in better germination.

Blue light gave results that were always the lowest except at the highest intensity where its effect was more promotive than that of white light. Borthwick et al. (1952) obtained both promotion and inhibition of germination of lettuce seeds by blue radiation depending upon the duration of the period the seeds have been allowed to imbibe water prior to irradiation (citation from Wareing and Black, 1958). As mentioned before, Evenari et al. (1957) have reported a promoting effect of blue light on germinating seeds. Czopek (1963) observed a similar effect of chromatic blue light when the germination of turions of *Spirodela polyrrhiza (Lemnaceae)* was enhanced and promoted by a daily ten minutes exposure to blue light although to a lower extent as compared to the promotion by white light. These findings coincide fairly here with our findings as regards the seeds of *Plantago major*.

In a trial to explain such results on the basis of the modern 'Low Energy Reaction' and 'High Energy Reaction' theories (M o h r, 1962), it can be said that the germination of *Plantago major* seeds is neither a strictly typical low energy reaction nor is it a strictly typical high energy one. Tthat it is not a low energy reaction is clear from the action of red light from interference filter which did not promote the dark germination of those seeds even when they were exposed to red light for a whole hour (R e z k II, 1968). On the other hand, that it is not a typical high energy reaction is vedidenced by the decline shown by the germination curve when the seeds were exposed to a relatively high intensity of white light.

Concluding from the studies on the light sensitivity of the seeds of *Plantago major*, we can say that this factor (light) plays an important ecological role in its survival and distribution, of course besides the other ecological factors (e.g. temperature, soil moisture, etc.). To get a successful set of seedlings of *Plantago major* seeds an adequate supply of light is needed to fulfil the great need of those seeds to that type

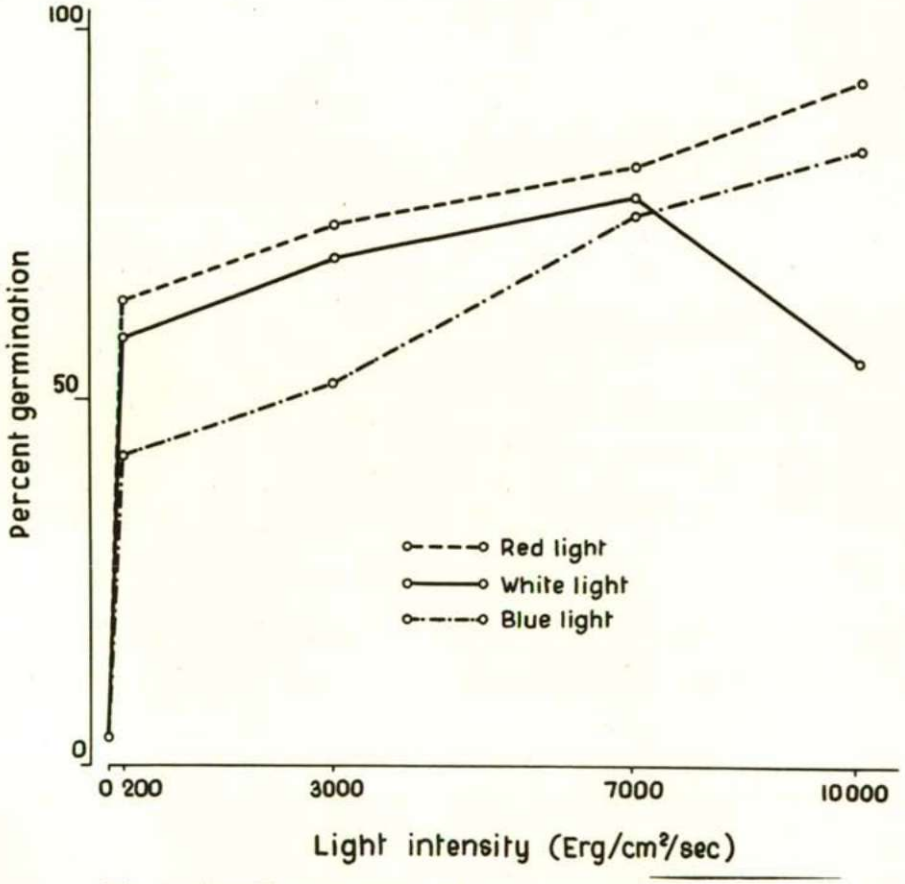

Fig. 1. The effect of white, red, and blue colours of light at different intensities on the germination of *Plantago major* seeds.

of energy. This is only available if the other ecological factors are optimal and if the seeds are not deeply sown below the soil layers. In Egypt this plant is characteristic of canal banks which form a type of favourable habitat for the settlement of *Plantago major* plants. The soil in such habitat is not regularly disturbed by ploughing practices and the shed seeds are always on or very near to the soil surface. Under such moist conditions of canal bank habitats the seeds receive their adequate requisites of water, oxygen, temperature, and light and so succeed to colonise such places. Their germination usually takes place late in autumn and so the quantity of light energy received by the germinating seeds is just adequate.

Summary

The effect of white, red, and blue colours of light on the germination of the seeds of *Plantago major* is studied. It is found that red light promotes the germination to the highest level followed by white and blue colours. The effect of white light at the highest intensity (10 000 erg (cm^2) sec) is inhibitory to the germination of those seeds.

The results are discussed in the light of the low energy reaction and the high energy reaction theories. The ecological bearing of the light-sensitivity of those seeds on the distribution of *Plantago major* is commented on.

Acknowledgment

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DIFFERENTIAL EFFECT OF RED AND BLUE LIGHT ON THE ACCUMULATION OF CARBOHYDRATES AND NITROGEN COMPOUNDS

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Introduction

There are contradictory data in literature concerning the problem whether a change in the spectral composition of light has any effect on the rate of accumulation of carbohydrates and nitrogen compounds. Cayle and Emerson (1957), Moyse et al. (1959), as well Bergmann and Balz (1966) stated, that there is no difference in carbohydrate and nitrogen content under red and blue illumination if the CO_2 fixation, resp. the increase of dry matter was kept on the same level. Similar data had been reported earlier by us (Szász, 1966). In some contradiction with that others (Kowallik, 1962; Hauschild et al., 1964; Voskresenskaya and Nechaeva, 1967) demonstrated, that the blue and red light affected the accumulation of carbohydrates and nitrogen compounds differently even if the dry matter production was the same.

Material and methods

Plants of soybean (*Glicine soya* cult. Rábakecöli fekete) were grown, simultaneously at three different light intensites (3.000, 8.000 and 12.500 ergs. $cm^{-2}sec^{-1}$), under controlled conditions, for a five week period. The illumination was presented by blue and red fluorescent lamps. In our climate chambers (Horváth, 1964) temperature varied between 15—25° C, humidity between 40—70 percent, in a daily rhythm. The plants were grown in pots of sand and Pryanisnikov's nutrient solution was used for irrigation.

The experiment has been repeated three times, and our data refer to 100—120 plants.

The plants were dried and determinations have been carried out from the dry material as follows: soluble carbohydrates, starch, soluble nitrogen and TCA precipitated protein fractions (Dubois et al., 1956; Kelley et al., 1946).

Results

The increase of dry weight of plants grown in blue and red lights is shown in Table I.

In the case of an identical dry weight accumulation, the carbohydrate and nitrogen contents in the leaves were significantly different in blue and red lights (Figs. 1 and 2). In roots and stems, there could not be demonstrated any differences.

Table I. Dry weight (mg) of soybean plants

light intensity ($ergs.cm^{-2}sec^{-1}$)	root		stem		leaf		whole plant	
	blue	red	blue	red	blue	red	bule	red
3.10^3	12,0	12,2	51,8	57,2	19,2	16,2	83,0	85,6
8.10^3	14,0	10,3	69,0	82,0	51,0	56,7	134,0	149,0
$12,5.10^3$	26,5	27,0	90,8	114,7	83,5	77,8	200,8	219,5
L.S.D. at 5 per cent level	4,7		8,7		9,7		22,6	

According to the figures the soluble carbohydrate and starch contents were higher in red light, and the soluble and protein nitrogen contents in blue one. Depending upon the dry matter accumulation, the red light increased the soluble carbohydrate content by about 27—48 per cent, and the starch content by 36—55 per cent. On the other hand, the blue light brought about an increase of the soluble nitrogen fraction of 31—62 per cent, and of the protein fraction of 25—33 per cent.

Figures show also the increase of the carbohydrate content and decrease of the soluble nitrogen content as a function of the dry matter accumulation.

Discussion

The demonstration of the stimulatory effect of blue light on the accumulation of nitrogen compounds is in good accordance with data of several authors, published on the synthesis of amino acids, resp. proteins (Ohlenroth and Mohr, 1964; Das and Raju, 1965; Christel and Bergmann, 1967).

On the basis of the data obtained we suppose that the spectral composition of light may have an immediate influence on the synthesis of carbohydrates and nitrogen compounds, and the differences which occur are not exclusively due to the changes of the dry matter accumulation.

The fact that the differences could have been shown only in the leaves refers to a connection with photosynthesis. We had earlier tried to correlate the formation of the determined carbohydrate and nitrogen

fractions from the Calvin cycle (Horváth and Szász, 1965). On the other hand, the effect manifested in the starch and protein contents, is showing that the change in the spectral composition of light exerts its influence not only via the photosynthetic reactions but other metabolic pathways may be effected as well.

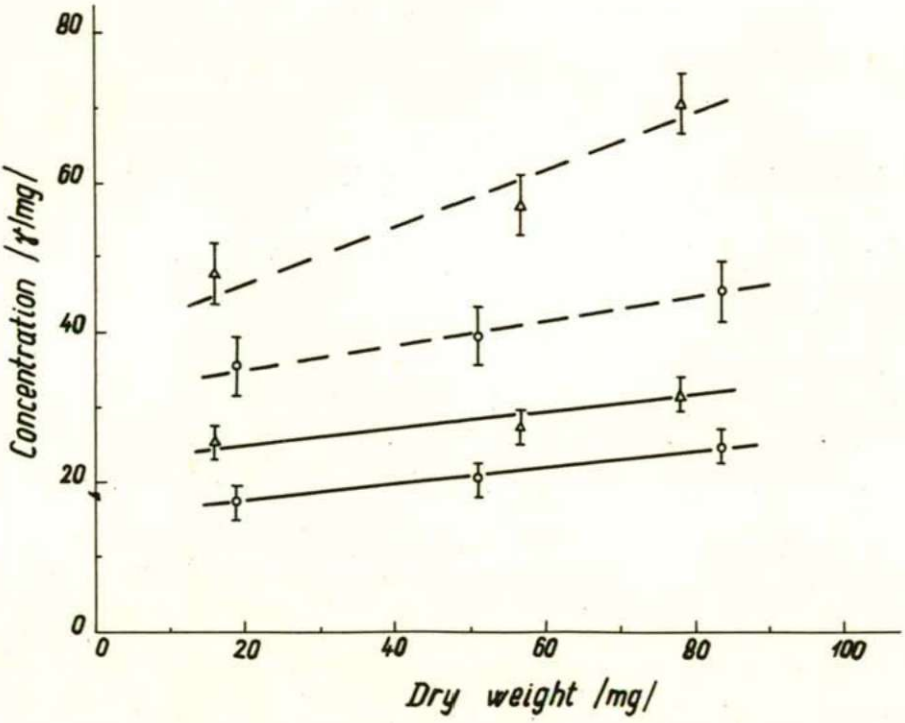

Fig. 1 Change of the soluble carbohydrate and starch contents in soybean leaves as a function of the dry weight accumulation. ———, soluble carbohydrates; — — —, starch; o, blue light; △, red light.

Summary

We investigated the effect of the spectral composition of light on the accumulation of carbohydrates and nitrogen compounds in soybean plants grown under controlled conditions. The examinations indicate:

1) In the case of an identical dry weight accumulation, in leaves, the soluble carbohydrate and starch contents were higher in red light, the soluble and protein nitrogen contents, however, in blue one.

2) In roots and stems no difference could be detected.

Authors suppose that the spectral composition of light has an immediate influence on the synthesis of carbohydrate and nitrogen compounds.

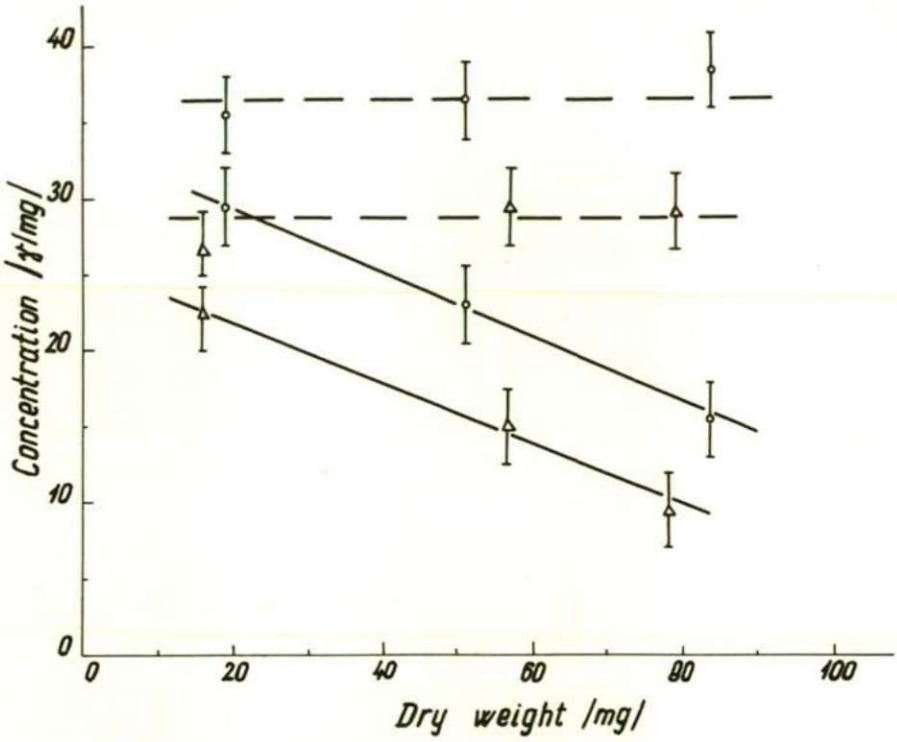

Fig. 2 Change of the soluble nitrogen and protein contents in soybean leaves as a function of the dry weight accumulation. ———, soluble-N; — — —, protein-N; o, blue light; △, red light.

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INVESTIGATIONS ON THE OLIGOSACCHARIDE DECOMPOSITION BY PICHIA WICKERHAMII (VAN DER WALT) VAN RIJ

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The pathways of the carbohydrate utilization of yeasts are important both from taxonomical and from industrial points of view and also in respect of the fermentation industry. As on the basis of theoretical deductions (Novák and Zsolt, 1961; 1962; 1964) the possibility of more ways of sucrose and maltose utilization seemed to exist, a series of experiments, dealing with uptake and cleavage of these oligosaccharides were started.

As to sucrose splitting, only the role of invertase was earlier accepted by taxonomists (Lodder and Kreger-van Rij, 1952), but later on some data were published demonstrating a possibility of sucrose splitting by maltase (group-specific α-glucosidase) in invertase-less yeasts (Kosikov, Gelyman and Raevskaya, 1956). According to Halvorson (1961), sucrose was split by all of the so-called yeast-maltase preparates too. Lindegren and Lindegren (1949), however, demonstrated in baker's yeast also an endo-enzyme splitting sucrose which differred from invertase not only by its localization but by its inactivity against raffinose as well. This enzyme showed sensitivity against lipid solvents and did not split maltose.

A sucrose splitting enzyme differring from invertase was observed by us first in *Candida solani* (Novák, 1963) and it was also demostrated that it was not identical with the "yeast-maltase". On the basis of its lipid solvent sensitivity, also a similar enzyme was later isolated by us (Novák and Zsolt, 1963a) from *Procandida albicans* — syn. *Candida albicans* (Novák and Zsolt, 1961) — on the basis of the behaviour of this enzyme against inhibitors it was established that it was not identical with the enzyme described by Lindegren et al. (1949) mentioned above (Novák and Zsolt, 1963b). Since then a similar enzyme was demonstrated by us in some other yeasts, too: *Candida requinyii*, *Procandida stellatoidea* and *Procandida grubyi* (Novák, Kevei, Oláh and Zsolt, 1965a,b,c).

Investigating the general occurrence of this enzyme in yeasts, first of all some species utilizing sucrose but not raffinose were tested.

In our present work the results of the investigation of splitting of sucrose, maltose and raffinose by *Pichia wickerhamii* are reported. This species assimilates glucose, sucrose and maltose but it ferments only glucose. Besides, an interesting comparison is given by the fact that *Procandida grubyi* investigated earlier (Novák, Kevei, Oláh and Zsolt, 1965c) shows a sugar assimilation pattern identical with that of *Pichia wickerhamii* but it ferments beside glucose maltose too.

Materials and methods

For the experiments a strain of *Pichia wickerhamii* received from van der Walt was used. It was cultivated on Csillag's molasses agar (Csillag, 1950) in Roux-bottles. The method of experiments, performed with intact and acetone treated cells and cell-free extracts, as well as the method of paper-chromatography were published earlier (Novák, 1960, 1961; Novák, Kevei, Oláh and Zsolt, 1965a).

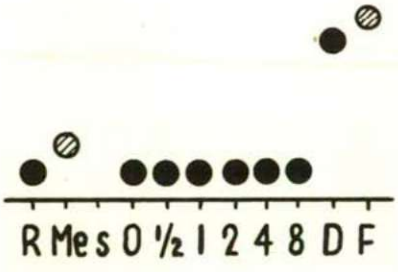

Fig. 1. Raffinose utilization by intact *P. wickerhamii* cells. 750 mg live wet cells and 60 mg raffinose in pH 7,2 M/30 phosphate buffer in 3 ml volume. Copy of the chromatogram. Left raffinose, melibiose and suspension, right glucose and fructose controls. Numbers under start line represent the sampling intervals in hours.

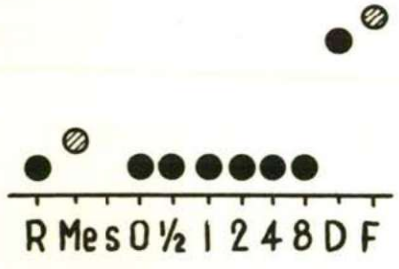

Fig. 2. Raffinose utilization by acetone treated *P. wickerhamii* cells. Acetone treated 750 mg live wet cells; others as indicated in Fig. 1.

Results

Raffinose splitting. Neither cleavage nor uptake of raffinose was demostrated by any preparates (Figs. 1—2).

Maltose splitting. The living and acetone treated cells neither splitted nor took up this sugar (Figs. 4 and 5), while in the cell-free extract maltose splitting was demonstrated (Fig. 6).

Sucrose splitting. The living and the acetone treated cells

neither splitted nor took up sucrose (Figs. 7 and 8), but in the cell-free extract sucrose splitting was found (Fig. 9).

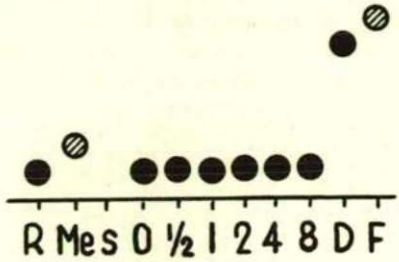

Fig. 3. Raffinose utilization by cell-free extract of *P. wickerhamii* cells. Cell-free extract of 500 mg live wet cells desintegrated with quarz sand and 40 mg raffinose in pH 7,2 M/30 phosphate buffer in 2 ml volume; others as indicated in Fig. 1.

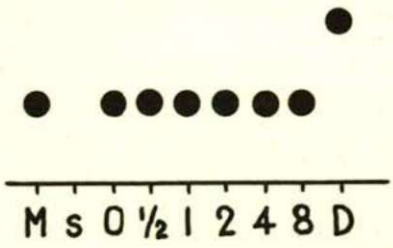

Fig. 4. Maltose utilization by intact *P. wickerhamii* cells. 750 mg live wet cells and 60 mg maltose in pH 7,2 M/30 phosphate buffer in 3 ml volume. Copy of the chromatogram. Left maltose and suspension, right glucose controls. Numbers under the start line represent the sampling intervals in hours.

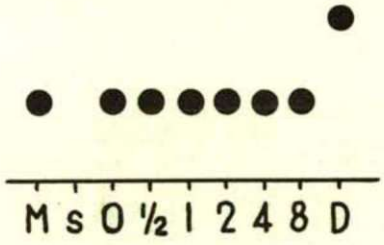

Fig. 5. Maltose utilization by acetone treated *P. wickerhamii cells.* Acetone treated 750 mg live wet cells; others as indicated in Fig. 4.

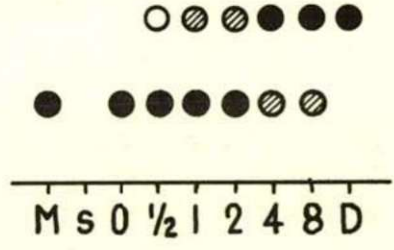

Fig. 6. Maltose utilization by cell-free extract of *P. wickerhamii* cells. Cell-free extract of 500 mg live wet cells desintegrated with quarz sand and 40 mg maltose in pH 7,2 M/30 phosphate buffer in 2 ml volume; others as indicated in Fig. 4.

Discussion

From incubations made with sucrose and raffinose it is seen that the sucrose splitting enzyme of *Pichia wickerhamii* is not of invertase type, because it does not cleave raffinose. The acetone sensitivity of it refers to its similarity (or identity) to the enzyme isolated by us from some other yeasts (Novák, 163; Novák and Zsolt, 1963a,b; Novák, Kevei, Oláh and Zsolt, 1965a,b,c).

The maltose splitting enzyme of *Pichia wickerhamii* differs considerably from those isolated by us from other yeasts (Novák 1961, 1963;

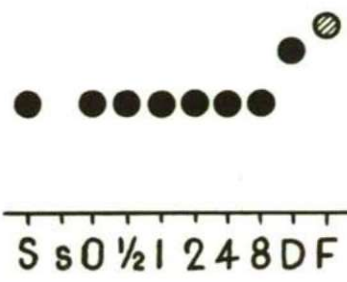

Fig. 7. Sucrose utilization by intact *P. wickerhamii* cells. 750 mg live wet cells and 60 mg sucrose in pH 7,2 M/30 phosphate buffer in 3 ml volume Copy of the chromatogram. Left sucrose and suspension, right glucose and fructose controls. Numbers under the start line represent the sampling intervals in hours.

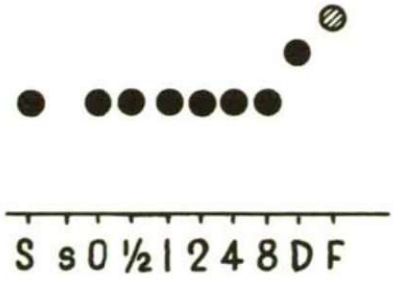

Fig. 8. Succrose utilization by acetone treated 750 mg live wet cells; others as indicated in Fig. 7.

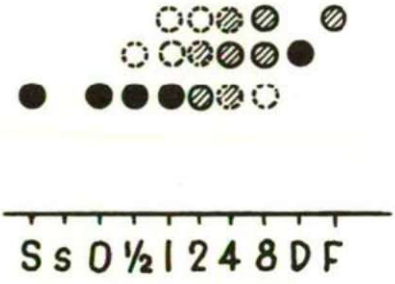

Fig. 9. Sucrose utilization by cell-free extract of *P. wickerhamii* cells. Cell-free extract of 500 mg live wet cells desintegrated with quarz sand and 40 mg raffinose in pH 7,2 M/30 phosphate buffer in 2 ml volume; others as indicated in Fig. 7.

Novák and Zsolt, 1963a,b; Novák, Kevei, Oláh and Zsolt, 1965b,c), because the former is acetone sensitive while the others are not. On the basis of these it is to be supposed that *Pichia wickerhamii* has an other type of maltose splitting enzyme than the species investigated by us earlier.

Comparing the results obtained on the living cells of *Pichia wickerhamii* with the same preparate of *Procandida grubyi* (Novák, Kevei, Oláh and Zsolt, 1965c), it can be established that no maltose consumption was observed even in suspensions of a high density (750 mg wet cells in 3 ml) i.e. the living cells did not take up maltose. In contrast to this, in the case of *Procandida grubyi* a maltose uptake was demonstrated in suspensions of a lower density (560 mg in 3 ml), too (Novák, Kevei, Oláh and Zsolt, 1965c).

Accordingly, in our incubation system during the investigation period, from the two maltose assimilating species only the maltose fermenting one *(Procandida grubyi)* took up this sugar in a demonstrable amount. Taking into consideration that our incubation method provides rather anaerobic conditions, it is plausible that only the species having anaerobic maltose metabolism take up this sugar and thus these results confirm in the case of maltose utilization the existence of two types (anaerobic and aerobic) of transportase systems and enzymes respectively.

Summary

Investigating the oligosaccharide decomposition of the yeast *Pichia wickerhamii*, no raffinose splitting enzyme was demonstrated. The sucrose splitting enzyme found in this species proved to be similar (or identical) to those isolated by us from other yeasts, too. The maltose cleaving enzyme of the investigated species, contrary to the other ones isolated from other yeasts, showed an acetone sensitivity.

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CHANGE OF PIGMENT CONTENT, PROTEIN CONTENT AND THAT OF THE RIBONUCLEASE ENZYME ACTIVITY IN INTACT PLANTS AND ISOLATED BARLEY LEAVES

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Introduction

In our experiments for studying the biologic role of roots, we have treated six days old intact MFB barley plants and leaves, detached from their roots, with running water, 10^{-2}M KCN, 2.10^{-6}M actinomycin D, and with a solution containing both inhibitors of metabolism together.

The days of treatment having advanced, the processes of decomposition became more and more conspicuous, manifested in a decrease of pigment content, and in an increase of the amount of the acid-dissolvable nitrogenous fractions and of the nucleic-acid fractions of little polymerisation. The activity of the ribonuclease enzyme has increased.

As regards the study of the functioning of a root system in the life of a plant, and its role in the processes of metabolism, it is an accepted method to register the metabolic changes taking place in the leaves detached from their roots. In a short time after the roots being removed, the decrease of pigment content and protein level of leaves can be observed (Chibnall-Wiltshire, 1954). This decrease is the most accentuated as regards the amount of chlorophyll-a, in connection with a decomposition of the protein complex (Horváth-Lásztity, 1967). The intensity of breathing is increasing (James, 1953) and a shifting of the balance of metabolic processes towards a decomposition can be observed. In the tissue extract of the leaves detached the oxidized NADP is present in a larger amount than in the leaves of intact leaves. Removing the roots is connected with an increased NADPH oxidization that refers to an important role of roots in regulating the respiratory tracts (Horváth-Udvardy, 1965). In the leaves deprived of their roots the amount of free amino-acid, of ammonia (Chibnall-Wiltshire, 1954) and, as a rule, that of nitrogenous compounds soluble in alcohol increases, and the whole RNA level decreases, while the DNA and the total phosphorus, *resp.* the total nitrogene content remain

unchanged (Martos, 1959). In the isolated leaves, the activity of the dehydrogenases of the pentose-phosphatic cycle (Udvardy-Horváth, 1964) and the ribonucleic activity increase (Bagi-Farkas, 1967; Lewis, 1967; Udvardy-Farkas, 1967). Some authors find similar to each other the metabolic changes produced by the roots removed, dried (Lewis, 1967) of infected, and the effect of root-function inhibitors — *e.g.*, tripoflavin. The roots being removed, the metabolic processes become, therefore, unbalanced showing that the root system is not only a site of the supply of materials but also that of other metabolic processes. We can, however, not succeed in clearing up these processes by removing the roots alone, because in the leaves damaged in that way there appear, apart from metabolic disturbances produced by the interruption of root function, other processes, as well, with a tendency of regenerating the root system, i.e., the disturbances caused by the damage (Horváth-Kovács, 1968). And the chemical inhibition of root function of the intact plants is raisling the question if the metabolic changes produced in the leaves by these materials are taking place only as an inhibition of some processes in the roots or the inhibitors, getting to the leaf, have their influence there, as well.

On the basis of the problems mentioned above, we have performed our investigations to observe the metabolic changes produced in the leaves by removing the root and applying some inhibitors.

Material and method

Our investigations were carried out with an MFB sort of barley. The plants were grown in washed river sand, treated with culture fluid, in an artificial plant growing place (Horváth-Lásztity, 1966) and in a greenhouse.

The six days old intact plants of rinsed roots, *resp.* the leaves detached were treated by being placed into tap water, 10^{-2}M KCN, 2.10^{-6}M Actonomycin D, and a solution containing together 10^{-2}M KCN and 2.10^{-6}M Actinomycin D. The concentration of the inhibitors used was selected out of a concentration series that was set previously. Plants from the same sowing and grown in sand for a longer time have been examined as a control.

The investigations were carried out from the first hour after treatment till the ninth day, in five repetitions. The determinations were performed on leaves of 1 g fresh weight. The parts damaged as a consequence of treatment were removed in every case.

The course of the determination of pigment was published in some previous articles of ours (Horváth-Lásztity, 1965).

The activity of ribonuclease enzyme was determined on the basis of the increase of fractions of little polymerisation of yeast soluble in RNA hydrochloric alcohol, demonstrated as a result of the enzyme, and on the basis of the UV absorphtion change, taking place on 260 mμ. The extinction increase of 0.01 as compared to the control is one enzyme unit (Tuve-Anfinsen, 1960; Venetianer, 1964; Dévay, 1965).

The determination of the nitrogenous compound soluble in trichloroacetic-acid of ten percent and that of the protein content were carried out according to Nessler, after being damaged by sulphuric acid.

The semi-quantitative determination of the nucleic-acid fractions of little polymerisation was carried out, after being solved in hydrochloric alchol, with a measurement of UV absorption on 260 mμ. The amount of the nucleic-acid fractions of large polymerisation was counted on the basis of the UV absorption of a fraction hydrolized with 0,3 M KOH for 18 hours in 37 C° and indissoluble in acidifeus alcohol, measured on 260 mμ. A standard curve has been made of yeast RNA (Tankó, 1958).

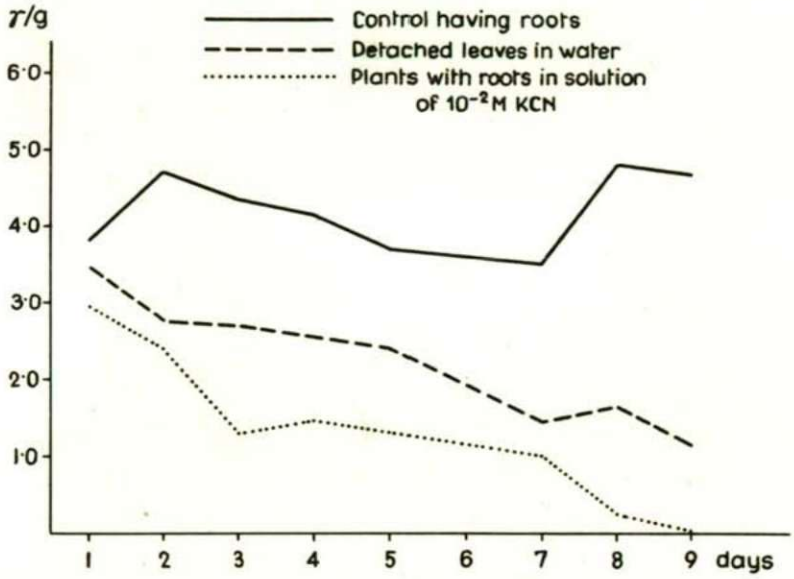

Fig. 1. Formation of the total pigment content, as a result of diferent treatments (γ/g) fresh weight)

Experimental results

In the course of our investigations we have demonstrated that both in the leaves of plants detached and put into water, and in those of intact plants treated with 10^{-2}M KCN, the total pigment content has decreased as a function of time and as compared to the control (Fig. 1).

In the leaves of control plants, in the total pigment content referred to the protein unit, the continuous increase can be demonstrated in the first nine days of treatment while in the leaves detached it does not differ essentially from the value measured in the first day during the same period. On the other hand, in the leaves of plants having roots and treater with 10^{-2}M KCN, the total pigment content referred to the protein unit is decreasing rapidly from the first day of isolation (Table I). The amonunt of chlorophyl-a and b has decreased from 29 p.c. to 11 p.c. and in the leaves of intact plants treated with a cyanide from 29 p.c. to zero, during the period of treatment while, in the same time, it increased from being one-third part of the total pigmet content to be half a part of it in the leaves of control plants (Table I).

Table I. Formation of the pigment content in barley leaves, as a result of a treatment.

Duration of treatment in days	Total pigment content (protein ratio) / pigment (mg protein)			Amount of Chlorophyl a+b in percentage of the total pigment content		
	Control having roots	Detached leaves in water	Plants with roots in a solution of 10^{-2}M KCN	Control having roots	Detached leaves in water	Plants with roots in a solution of 10^{-2}M KCN
1	0,23	0,27	0,18	32	29	29
2	0,44	0,21	0,15	34	33	30
3	0,45	0,23	0,07	38	34	27
4	0,47	0,33	0,07	46	44	27
5	0,71	0,31	0,06	44	34	25
7	0,57	0,25	0,09	52	26	10
8	0,48	0,29	0,03	46	18	7
9	0,73	0,24	0,00	51	11	0

Being influenced by the treatment, the quantity of the acid-soluble nitrogenaus fraction has increased, as demonstrated by the value of these fractions reckoned over into protein units (Table II).

The amount of nucleic-acid fractions of little polymerisation considerably increases in the leaves treated, as compared to the controls (Fig. 2). The increase of the nucleic-acid fractions of little polymeri-

Table II. Formation of the ratio of protein content (mg) of soluble nitrogenous fractions (mg) in barley leaves, as a result of a treatment

Duration of treatment in days	Control with roots	Detached leaves in water	Plants with roots in a solution of 10^{-2}M KCN
1	0,05	0,09	0,09
2	0,09	0,13	0,16
3	0,08	0,17	0,22
4	0,09	0,28	0,14
5	0,11	0,17	0,14
7	0,07	0,24	0,30
8	0,09	0,42	0,33
9	0,12	0,60	0,20

sation is not followed by an increase of the fractions of large polymerisation, as demonstrated by the formation of proportion of these two fractions (Table III).

Table III. Formation of the ratio of nucleic acid fractions of large polymerisation (mg) and those of little polymerisation (mg) as a result of treatment

Duration of treatment in days	Control having roots	Detached leaves in water	Plants with roots in a solution of 10^{-2}M KCN
1	1,7	2,3	2,0
2	1,9	2,7	2,3
3	2,0	3,2	4,5
4	2,0	3,0	2,8
5	1,5	2,5	2,4
7	1,7	2,3	2,5
8	2,3	3,3	3,8
9	2,8	3,6	5,3

Table IV. Formation of the enzyme activity of ribonuclease in barley leaves, as a result of treatment (enzyme-unit/g fresh weight)

Duration of treatment in hours	Control having roots	Detached leaves in water	Plants with roots in a solution of 10^{-2}M KCN
1	1365	1190	1470
3	1190	1260	1085
6	1505	1330	1960
8	1155	1260	1680
12	1260	1155	1575
16	1260	1645	2240
24	1260	1645	3115

The activity of ribonuclease enzyme has increased essentially, as compared to the control, in the leaves detached and put into some water from a tap twelve hours after the isolation. This increase may be observed in the leaves of intact plants treated with a cyanide as soon as after two hours (Table IV). The considerable activity could be observed during our investigations even on the ninth day of isolation, both as a consequence of being detached and treated with a cyanide. The highest activity values were measured, in every case, in the leaves of plants treated with a cyanide (Table V).

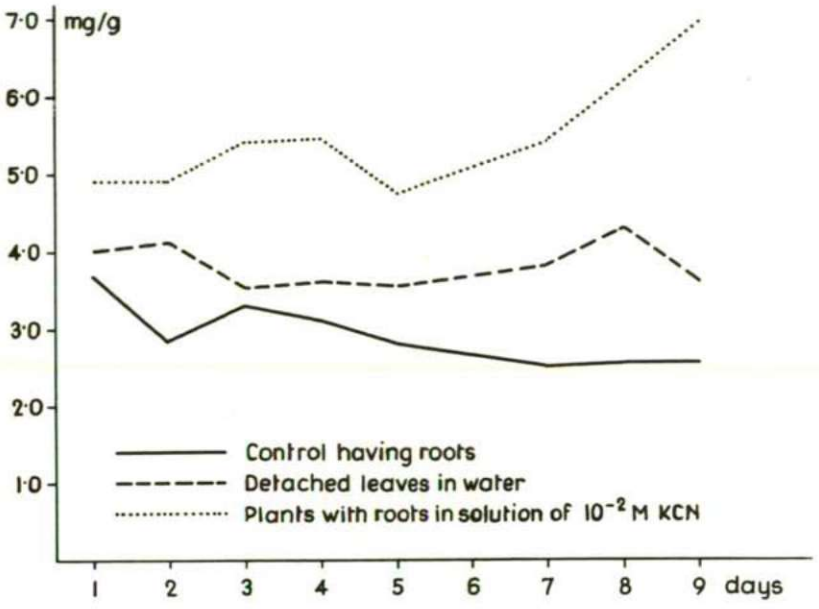

Fig. 2. Foramtion of the quantity of nucleic-acid fractions of little polymerisation — soluble in acidic alcohol — as a result of different treatments (mg/g fresh weight)

Table V. Formation of the enzyme activity of ribonuclease as a result of treatment, referred to a unit quantity of protein (Enzyme unit/mg protein)

Duration of treatment in days	Control having roots	Detached leaves in water	Plants with roots in a solution of 10^{-2}M KCN
1	100,2	121,7	230,4
2	109,1	130,2	258,8
3	135,8	122,4	299,9
4	153,0	191,3	274,6
5	203,4	224,1	324,6
7	165,3	287,3	757,4
8	126,0	377,5	942,5
9	136,5	230,6	513,3

Table VI is demonstrating the influence of the treatment with 10^{-2}M KCN in tap water, with 2.16^{-6}M Actinomycin D, resp. with the

joint application of the two latter metabolic inhibitors, upon the protein content of leaves and the development of the ribonuclease enzyme activity in intact plants and in leaves detached.

Table VI. Formation of protein content and ribonuclease enzyme content, as a result of different treatments, in barley leaves detached and in those having roots. In this experimental series the plants were grown in greenhouse.

Duration of treatment in days	Plants having roots					Leaves detached			
	In sand (control)	In water	In 10^{-2}M KCN	In 10^{-6}M Actinomycin D	In 10^{-2}M KCN + 2.10^{-6}M Act. D	In water	In 10^{-2}M KCN	In 2.1^{-6}M Actinomycin D	In 10^{-2}M KCN + 2.10^{-6}M Act. D
	Protein content/mg protein/g fresh weight								
1	34,38	27,50	44,53	25,47	20,78	28,91	37,03	28,13	23,28
4	26,41	16,09	18,59	16,41	17,34	20,94	20,31	10,78	10,94
	Ribonuclease activity (enzyme unit/mg protein)								
1	37,6	82,7	75,4	74,2	215,5	55,6	92,6	59,7	372,8
4	58,3	139,2	161,7	145,0	316,9	191,9	449,6	172,0	946,9

According to our results, the protein content decreases in every case till the fourth day of treatment. As a result of a treatment with cayanides, both in the leaves of the plants having roots and in the leaves detached, the protein content is higher after a treatment of one day than it is in the control; on the fourth day of treatment, however, even that declined under the value of control. As a result of all the other treatments applied, the decrease of protein content as compared to the control could be demonstrated as soon as after the first day. This decrease is the most expressed as a result of Actinomycin D.

The enzyme activity of ribonuclease increases in every case till the fourth day of treatment. From the different treatments, the joint application of Actinomycin D and KCN shows a conspicuous increase in activity as compared to the untreated control as soon as after the first day. This increase is even more expressed on the fourth day of treatment, giving the highest value of all variations both in the leaves of intact plants and in leaves detached, on the fourth day of treatment (Table VI).

Discussion

According to our experimental results, in the leaves of a six days old barley plant, treated as having roots on being detached, essential differences can be demonstrated as to the development of some characteristics of metabolic processes investigated by us and compared to a control, already after a treatment of one day.

The prevalence of disintegrating processes is shown by the decrease of pigment content as a result of treatment, and by the increase of the amount of the nitrogenous fractions dissolvable in acid and of the

nucleic-acid fractions of little polymerisation, as well by that of the enzyme activity of ribonuclease.

The change of pigment content is first of all shown by the destruction of chlorophyl-a and b. The beginning of a disintegration of green pigments precedes the decrease of protein content, and a full decomposition takes place, as a result of cyanide, as early as on the ninthday of treatment.

According to our results it seems so that the disintegrating processes occur more intensively as a result of cyanide than as a result of the roots being mechanically removed. This observation is supposed also by a change of the enzyme activity of ribonuclease. The enzyme activity increases if damages intensify, being more expressed if influenced by a cyanide than by the roots detached. Therefore, achange in the enzyme activity of ribonuclease is a sensitive indicator of factors influencing the nucleic-acid metabolism, occurring, as demonstrated by Lewis (1967), not only as a result of the removal of roots and of the inhibitors but for instance also as a consequence of a possible scarcity of water.

In the leaves of control plants, as well, an increase of the ribonuclease activity can be demonstrated, on a small scale, in the process of growing old, accompanying a small decrease of protein content. Its cause may have been that the growth of the first leaf had been completed. The activity of ribonuclease is higher in case of every treatment than in the control with roots, and the increase in activity is more and more as the time of treatment is progressing. The increase of enzyme activity is accompanied by a growth of protein content only in case of cyanide treatment, after being treated for one day. In the same variations after a treatment of four days and as a result of every other treatment, the ribonuclease activity increasing more and more may be observed with a decreasing protein content. The ribonuclease activity compared to a control was increased on a small scale by Actinomycin D, being used as an inhibitor of protein synthesis, on the fourth day of treatment, a value elicited by a cyanide could, however, not be obtained. The greatest activities measured were obtained by a joint application of both metabolic inhibitors.

As a result of potassium cyanide, after a treatment of one day the protein content is higher than in leaves untreated; on the fourth day of treatment, however, it is already lower than the control value. Actinomycin D applied separately and together with KCN has induced a decrease of protein content. The enzyme activity of ribonuclease increased in every case as compared to the control, quite apart from the protein content increasing or decreasing.

From the different degrees of the efficiency of inhibitors — manifested *e.g.* in the different activities of ribonuclease — and from the e comparative difference of the metabolic indicators of intact plants, *resp.* of leaves detached the conclusion can be drawn that the influences of the two metabolic inhibitors applied for increasing destruction are controlled by the root system in different ways of metabolism.

Our results are reasing the question af a necessary application of further metabolic inhibitors and of the investigation of the activity of other enzymes for clearing up the problem of control of mechanism.

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DATA TO THE KNOWLEDGE OF INNERVATION OF THE BIRD'S DIGESTIVE TRACT

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The problem of innervation of the intestinal tube and that of the origin of the automatic intestinal motions belong to he highly important and interesting fields of the neuro-histological investigations. Dogiel had studied, already in 1896—97, the plexuses in the wall of the gastro-intestinal system, and classified the nerve cells into different types. Later on, the examinations have been extended to nearly every group of vertebrates, thus there were investigated the single parts of the digestive organs, resp. inside them the nerve connections of the different layers, in fish (Kolossow et al., 1930; Ábrahám, 1933a; 1933b; Milochin, 1963), *Amphibia* (Horváth, 1959; 1962), *Reptilia* (Kolossow, 1929), *Mammalia* and men (Esveld, 1928; Harting, 1934; Botár, 1942; Bargman, 1943; Greving, 1952; 1954; Iwanowa, 1957; Jabonero, 1958). The results of the comparative neuro-histological investigations concerning the innervation of the digestive tract appeared in the papers of Okamura (1966), Oshima (1929), Sotelo (1954), Stöhr (1949; 1957) and Temesrékási (1955).

The data concerning the structure of the nervous system in the digestive system of birds are to be found in the works of Ábrahám (1934; 1935; 1935/36; 1936; 1938), Iwanow (1930), Kolossow, Sabussow and Iwanow (1932). The nerve plexuses of the bird's intestinal tube are compared with that of other vertebrates by Kolossow (1959), Kolossow and Iwanow (1930), Okamura (1934) and Temesrékási (1955). The researchers have usually studied the structure of ganglia in the plexuses, the types of nerve cells in the ganglia, and their distribution.

Appearance and pattern of the receptors in the field of the system were investigated by Ábrahám (1966; 1967), Kolossow, Sabussow and Iwanow (1932), Milochin (1963), Stöhr (1949), Temesrékási (1955).

In the enumerated works there can be found a lot of data corresponding to one another, although in several questions the opinions of researchers are contradictory. We have found the most problems and contradictions in the interpretation of receptors and effectors in the field of the system.

My comparative investigations, carried out in different species, would like to amplify our knowledge concerning the innervation of the bird's intestinal tract. My observations are affecting the structure of intramural plexuses, the types of cells in the ganglia, their occurrence as well the form and structure of receptors appearing here and there.

Material and methods

I have used the intestinal tract of sixteen species of birds to my investigations. The collected material, on the basis of Dudich's system, belongs into the following orders.

Gulls *(Lariformes)*. Black-headed gull *(Larus ridibundus* L.), herring guu *(Larus fuscus* L.), silver gull *(Larus argentatus* B.).

Ducks *(Anseriformes)*. Poachard *(Anas platyrhyncha* L.), small duck *(Anas crecca* L.), domestic duck *(Anas domesticus* L.).

Water-rails *(Ralliformes)*. Common coot *(Fulica atra* L.).

Herons *(Ardeiformes)*. Black stork *(Ciconia nigra* L.), glossy ibis *(Plegadis falcinellus* L.).

Pigeons *(Columbiformes)*. Turtle-dove *(Streptopelia turtur* L.), Stock-dove *(Streptopelia decaocto* Friv.), pigeon *(Columba domestica* L.).

Hens *(Galliformes)*. Hen *(Gallus domesticus* L.), guinea-fowl *(Numida meleagris* L.), turkey *(Meleagris gallopavo* L.).

Sparrows *(Passeriformes)*. Sparrow *(Passer domesticus* L.).

After dissection, the intestinal canal has been conserved in neutral formalin of ten percent. The sections made with a freezing microtome were silvered with the procedures of Ábrahám, Bielschowsky-Ábrahám, Bielschowsky-Gros-Cauna, and Jabonero.

In the following I am going to discuss the conditions found in some parts of the intestinal tube, taking into consideration the points of view suitable for being compared and the establishments published in literature so far. First of all I review the nerve connections of oesophagus, then those of the glandular portion of ventricle *(proventriculus)* and, the gizzard *(ventriculus)*, intestine *(intestinum)*, and *cloaca*.

Oesophagus

Meissner's *plexus* takes place in the *lamina propria* in the *oesophagus*. In its structure some fibres myelinated and non-myelinated are participating, forming wavy trunks of different sizes. Beside them there occur smaller and bigger nerve cells that are always bigger in the lower third part of the *oesophagus* and in the area of crop than in the upper parts of *oesophagus*. The nerve cells are mostly multipolar though also unipolar ones can be observed among them. The multipolar nerve cells are of type Dogiel I. and rarely of type Dogiel II. The cell body is spherical, rarely elliptic, in them the nucleus and sometimes the neurofibrils, can be distinguished very well.

The *epithelium* and the glands of *oesophagus* possess a lot of nerve-fibre bundles, divided into several branches especially under the glands, sometimes run over from the *lamina propria* to the stratified squamous *epithelium* (Iwanow, 1930). I have observed such intraepithelial nerve fibres in the stratified squamous *epithelium* of *oesophagus* of the black stork where the fibre is showing a mildly wavy course among the

epithelial cells, running more or less parallel with the internal surface (Table I, fig. 1).

Between the two layers of the *tunica muscularis,* Auerbach's *plexus* takes place. Its nerve trunks and ganglia are bigger than those of Meissner's *plexus.* At *Columbiformes,* at glossy ibis the ganglia are massive, the cells are generally located in the middle of ganglia, while at guineafowls, hens and gulls the location of cells is more scatterred (Table I, fig. 2). The most part of nerve cells are representing type Dogiel I. though, in the ganglia of the crop, some cells of type Dogiel II. occur, as well (Ábrahám, 1935; 1936; Iwanow, 1930). There are solitary nerve cells, too, their number and appearance isn't showing, however, any regularity. At gallinaceans we could, anyway, observe that the ganglia and solitary cells of Auerbach's *plexus* may get down even to the border of the *tunica muscularis* and *tunica adventitia,* either. The outer lamina of the muscle layer is namely very weakly developed there.

Some peculiar thick-fibre branchings were visible in the connective-tissue *septum,* separating the two *laminae* of the *tunica muscularis externa.* They are probably receptors. Their fibres tear apart all at once or successively into several branches. I could not observe the termination forms of the end fibres starting from the branches (Table I, figs. 3, 4).

Glandular portion of ventricle *(proventriculus)*

The plexuses of glandular ventricle differ in many aspects from the plexuses of *oesophagus.* The *plexus submucosus Meissneri* is poorer in ganglia. Besides the ganglia, the solitary cells of uni- and bipolar forms are very characteristic. However, the most frequent cells in this *plexus* are the multipolar type Dogiel II. The nerve fibres of the *plexus* are isolated or they form small nerve trunks and may be observed mainly in the interglandular connective tissue. One part of the fibres go into the gland *parenchyma,* forming fine plexuses there in the substance of connective tissue. The latter ones are left by varicose fibres that can be followed until the bases of the gland cells.

The ganglia of Auerbach's *plexus* are extremely varied concerning their sizes and structures. They are of highly large extension at guinea-fowls, domestic ducks, and pigeons while at other species they are much smaller. This may particularly be observed in Auerbach,s *plexus* of the glandular ventricle of black storks. The multipolar cells of the *plexus* are considered by Iwanow (1930) to be mainly of type Dogiel I., but by Ábrahám (1935) of type Dogiel II. I myself consider the second opinion as verified.

In the connective tissue joint to the inner layer of *tunica muscularis,* in the black storks, black-headed gulls, herring gulls, hens, pigeons and stock-doves, I have observed peculiar nerve-fibre endings. The termination systems of largest extension may be found in the black storks and headed gulls. It is characteristic that a thick fibre is torn into many branches seemingly with anastomoses. Judged from their structure, they may be considered receptors. The most usual ones of them are of cornered and round formations (Table II, figs 1, 2). There are peculiar coil-like terminations in the muscle layer of the *proventriculus* of glossy ibis, resp.

in the connective-tissue between the muscular layers (Table II, fig. 3). All these endings can be considered as pressoreceptors (Ábrahám, 1966; 1967) receiving the *stimulus* of pressure exerted on the stomach wall.

Gizzard (ventriculus)

The nerve supply of muscular ventricle is assured, as well, by the two nerve plexuses. It is characteristic of the structure of plexuses that in Meissner's *plexus* there cannot be observed any ganglia of a major extent. We could find here either solitary nerve cells or small ganglia containing quite few cells. In Auerbach's *plexus*, apart from the solitary cells, also larger ganglia can be observed. Their multipolar nerve cells belong to type Dogiel II. In the muscular ventricle I could not see any receptory nerve-ending.

Intestine (intestinum)

From the different parts of the bird's intestinal tube the largest nerve supply was found in the intestine and especially in the *duodenum*. Both plexuses are very rich in fibres and nerve cells. The location of the vegetative trunks demonstrate a high degree regularity by the fact that the thicker bundles are rent into smaller ones and farther on these are again united in larger ones. At the meeting place of nerve trunks there are mostly ganglia, here too. In the ganglia the fibres remain almost in the background beside the cells. The cells are generally of the same size, except in the *duodenum* of black storks where the cells are comparatively small (Table II, fig. 3); in the *ileum* fo the glossy ibis and turkey (Table III, fig. 1), however, the nerve cells, of the type Dogiel II, occurring isolated, are conspicuously large. In the intestinal tract everywhere, and particulary in the intestines, the vegetative trunks become obviously thinner and thinner in the course of their repeated branchings. These trunks, as well the isolated fibres, permeate the smooth musculature densely, producing rich plexuses owing to the gradual branching among the smooth muscle cells.

Table I.

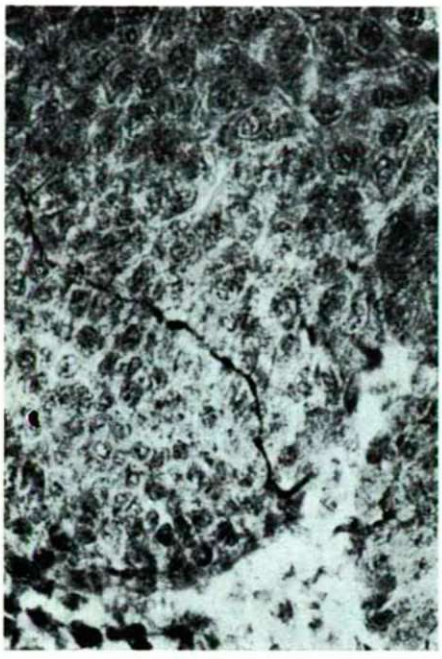
Fig. 1. *Ciconia nigra: Oesophagus.* Intraepithelial end-fibre. Ábrahám's method. Magn. x 300.

Fig. 2. *Larus ridibundus: Oesophagus.* Detail from the Auerbach *plexus*. Bielschowsky-Gros-Cauna's method. Magn. x 300.

Fig. 3. *Ciconia nigra: Oesophagus.* Thick fibre ramification. Ábrahám's method. Magn. x 300.

Fig. 4. *Ciconia nigra: Oesophagus.* Sersory ending. Ábrahám's method. Magn. x 300.

TABLE I



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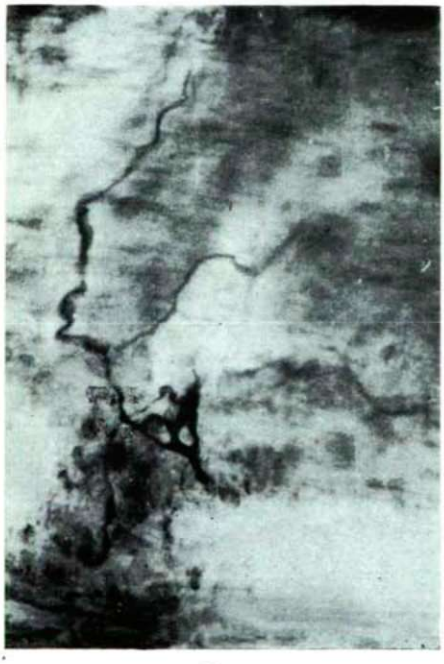

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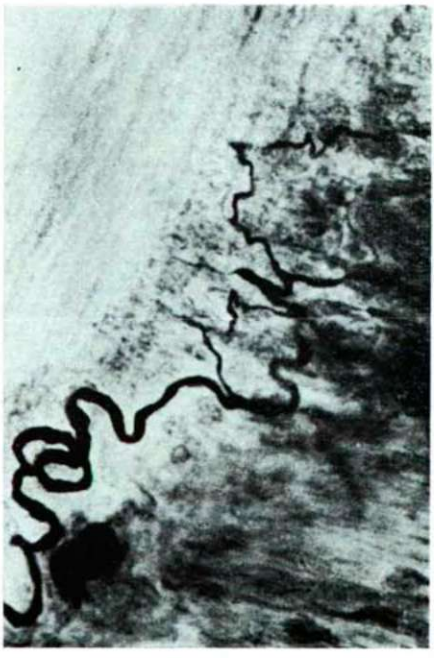

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TABLE II

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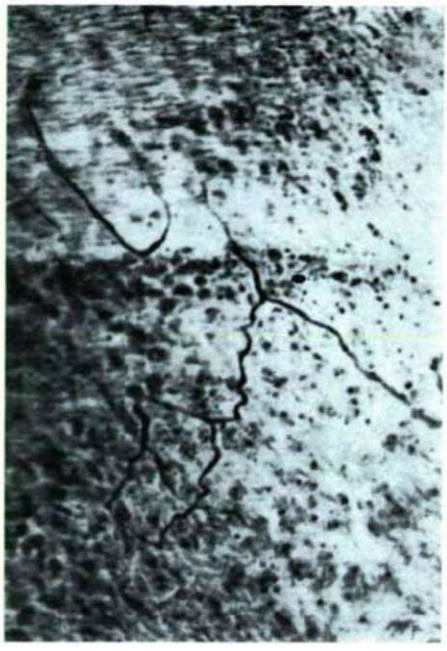

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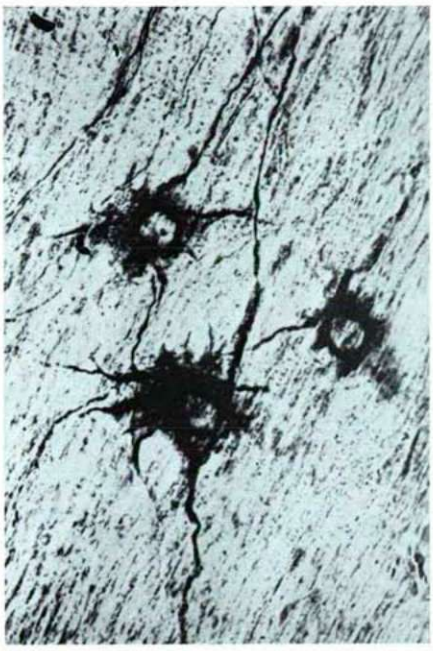
TABLE III



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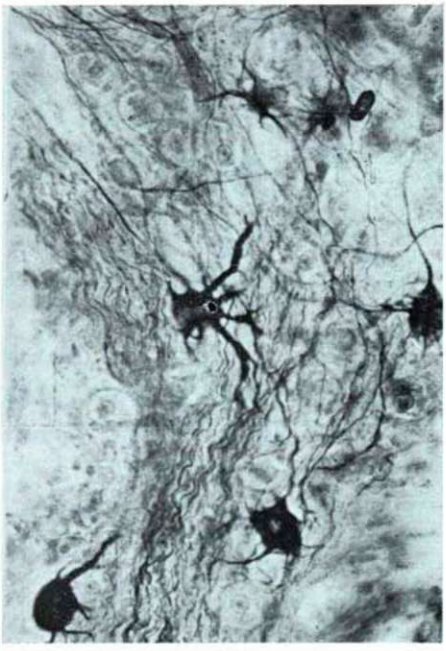

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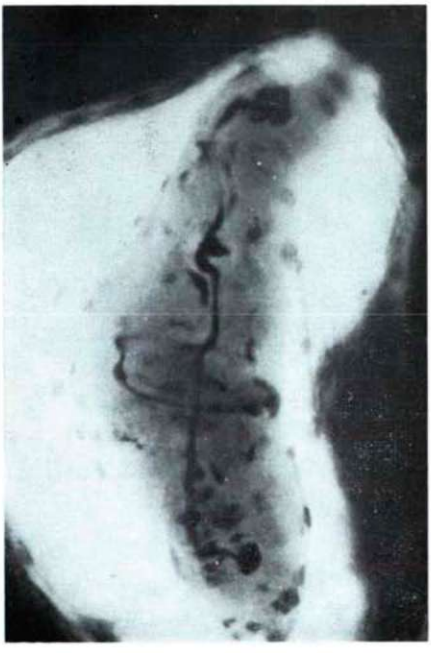

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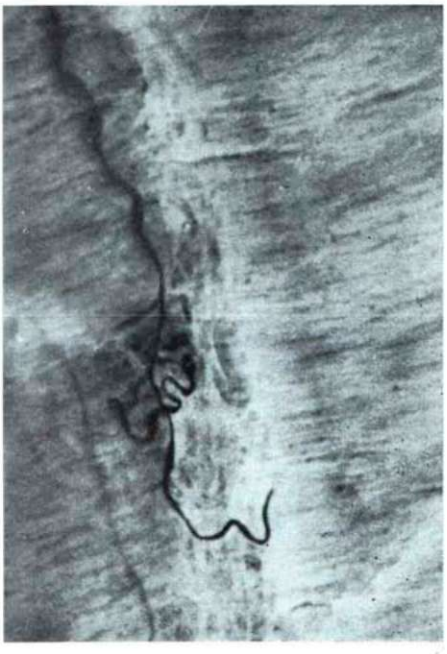

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Cloaca

The anatomically separated parts of the *cloaca* are different concerning their innervation. The plexuses of *coprodaeum* and *urodaeum* appear differing from the previous sectors of the intestinal canal by their ganglia being scatterred, containing relatively few cells which belong mostly to the type Dogiel II. (Table III, fig. 2). In the *proctodaeum* there couldn't be observed any ganglia. Although the *cloaca* is poor in nerve cells, it is extremely rich in nerve fibres and, probably, in nerve terminations, as well. Its enormous trunks have a course being here and there more strongly, in other places more mildly wavy. Some of the nerve terminations take place in the connective tissue, others in the musculature. In the connective tissue two kinds of the sensory nerve terminations could be separated, namely Herbst's nerve terminations and the so-called "free coil-formations". Herbst's nerve terminations are by and large identical with the terminal form derived from the beak skin. It may be mentioned as a matter of curiosity that in sections made from the *proctodaeum* of a hen I have observed also Herbt's terminations where the nerve fibre entering the connective tissue capsule makes a loop at about the middle of it (Table III, fig. 3).

"Free coil-formations" can mostly be observed among the striated muscle fascicles of *tunica muscularis*. First Ábrahám (1935/36) described these coils which differ in their appearance from the typical free convolutions because here fibre fascicles and not isolated fibres occur. The nerve fibre fascicles always leave the coil after some milder bends.

In the connective tissue between the two smooth muscle layers of *tunica muscularis*, a loose coil was observed to be produced by thin fibres. The thin fibre takes several mild bends in a comparatively small territory, and then leaves it becoming a little thinner (Table III, fig. 4).

Table II.

Fig. 1. *Larus ridibundus: Proventricle.* Baroreceptoric ending Bielschowsky's method. Magn. x 600.

Fig. 2. *Larus ridibundus:* Proventricle. Sensory endsystem. Bielschowsky-Gros-Cauna's method. Magn. x 600.

Fig. 3. *Plegadis falcinellus:* Proventricle. Sensory coil. Ábrahám's method. Magn. x 600.

Fig. 4. *Ciconia nigra: Duodenum.* Ganglion from the Auerbach *plexus.* Ábrahám's method. Magn. x 300.

Table III.

Fig. 1. *Plegadis falcinellus: Ileum.* Nerve cells of the Auerbach *plexus.* Jabonero's method. Magn. x 600.

Fig. 2. *Numida meleagris: Cloaca.* Nerve cells in the Auerbach *plexus.* Ábrahám's method. Magn. x 300

Fig. 3. *Gallus domesticus: Cloaca.* Herbst body Jabonero's method. Magn. x 600.

Fig. 4. *Ciconia nigra: Cloaca.* Nerve coil from the connective tissue between the two muscular layers. Ábrahám's method. Magn. x 300.

The musculature of the lower third part of *cloaca* is constructed by striated muscle fibres. Among the muscle fibres there can be found bigger and smaller nerve-fibre bundles. There are here a great number of thin fibres of central origin running among the muscle fibres after having left the trunks. The fibres end in small terminal heads that can be observed very well in some rather thick sections.

Summary

I can summarize the results of my investigations carried out on the intestinal tract of sixteen bird species with different procedures of nerve impregnation.

1. The two nerve plexuses that are generally characteristic of the intestinal tube can be found in the whole length of the bird's intestinal tract. A difference can be observed but in the position of plexuses. In the *oesophagus* the *plexus submucosus Meissneri* lies in the *lamina propria,* while Auerbach's *plexus* descends, here and there, even till the border of *tunica adventitia,* resp. *tunica serosa.*

2. The cells of plexuses are uni-, bi- and multipolar. The multipolar nerve cells may be classed among types Dogiel I and II.

3. The myelinated nerve fibres with central origin are partly intra-epithelial fibres, partly free coils, and partly dendritic branches.

4. The nerve fibres of sympathic origin form a delicate *plexus* system in the smooth musculature, the terminal fibres of which are ending among the muscle cells, resp. on these cells.

5. The dendritic branches are to be considered as pressoreceptoric (baroreceptor) nerve terminations of the intestinal tube.

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NEUESTE ANGABEN ÜBER DIE BALANIDENFAUNA DES PONTOKASPIMEDITERRANEUMS

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Ich möchte versuchen einen Überblick darüber zu geben, welche interessanten Eigenschaften der Frage der Entwicklung der Balanidenfauna des miozänischen und rezenten Pontokaspimediterraneums hinzuzufügen möglich sind. Der leichteren Übersicht halber teile ich das ganze große Tertiärgebiet, von dem ich Material hatte, folgendermaßen auf:

I. Das Mittelmeer
II. Das Schwarze Meer
III. Das Aralokaspikum (Turkmenistan, Kizil-Kos, Üzbekistan und Aralsee-Gegend.

In den folgenden Textteilen werden die Gebiete kurz als MED, PONT und ARCA bezeichnet. Die sporadischen Funde werden angegeben, wie z.B. Sizilien, Sardinien usw. Übrigens siehe die genaueren Arten-Angaben in der zitierten Literatur.

Seit 30 Jahren (1936—1966) befasse ich mich mit den Problemen der Balanidenfauna des Pontokaspimediterraneums. Mein Material entstammt den folgenden rezenten und fossilen Fundorten: Algerien, Aralsee-Gegend, Bulgarien, Dazien, Frankreich, Griechenland, Italien, Jugoslavien, Kaspischen Meer, Marokko, Nordafrika, Nordungarn, Ostbecken des Mittelmeeres, Pannonien, Spanien, Schwarzes Meer, Turkmenistan, Tunesien, Ukraine, Üzbekistan, Westbecken des Mittelmeeres.

Die Artennamen, die Literaturbeziehungen in Parenthesen und die wichtigeren Anmerkungen sind die folgenden:

Subgenus: *Megabalanus*

1. *Balanus (Megabalanus) tintinnabulum* Linne — mit einigen Unterarten (Kolosváry, 1952, Kolosváry, 1962, Davaide, 1963, Müller, 1965, David, 1967, Stublings, 1967). — MED fossil: Oligozän. Miozän, Pliozän und Quartär. — MED rezent: Mittelmeer, Adria. ARCA fossil: Oberes Oligozän (epakmische Exemplare). — Zur Zeit circumtropisch.

2. *Balanus (Megabalanus) tulipiformis* Ellis — (Kolosváry, 1960/61, Davaide, 1963, Müller, 1965, Stublings, 1967). — MED fossil: Miozän sowie Quartär. — MED rezent: im Westbecken des Mittelmeeres.

3. *Balanus (Megabalanus) hungaricus* Kolosváry — (Kolosváry, 1952). MED fossil: nur in Pannonien. Promontorium im unteren Miozän oder in Oligozän-Grenzschichten auf *Ostre*-Schalen.

4. *Balanus (Megabalanus) ajax* Darwin — (Kolosváry, 1951). — MED fossil: Pannonien, im Miozän selten. Zur Zeit tropisch.

5. *Balanus (Megabalanus) legányii* Kolosváry — (Kolosváry, 1952). — MED fossil: in Nordungarn in Miozänschichten vereinzelt.

6. *Balanus (Megabalanus) transsylvanicus* Kolosváry — (Kolosváry, 1952). — MED fossil: in Dazien in Tortonien-Schichten; nur Operkularplatten vorhanden, welche an die Operkularien der Megabalaniden erinnern.

Subgenus: *Conopea*

7. *Balanus (Conopea) salceolus* Ellis — (Kolosváry, 1951, Davaide, 1963, Stublings, 1967). — MED fossil: im Miozän. — MED rezent: Cap Blanc in Tunesien. Intergiert: ohne Subspecies; auch circumtropisch.

Subgenus: *Balanus*

8. *Balanus laevis* Bruguiére — (Kolosváry, 1952, Davaide, 1963). — MED fossil: in Pannonien und Nordungarn in Burdigalien und Tortonien; auch in Algir aus den Vindobonien Pliozänzeiten gemeldet. Zur Zeit substropisch; one Unterarten.

9. *Balanus perforatus* Bruguiére — (Kolosváry, 1960/61, Davaide, 1963, Stublings, 1967). — MED fossil: Oligozän, Miozän, Pliozän und Quartär. — MED rezent: im allgemeinen, mit Unterarten.

10. *Balanus amphitrite* Darwin — (Kolosváry, 1951, 1952, 1962, Davaide, 1963, Stublings 1967!) mit mehreren Unterarten auch fossil und rezent. Eine sehr variable Art. — MED fossil: Oligozän, Pliozän und Quartär. — MED rezent: im allgemeinen. — ARCA fossil: in Burdigalien. — PONT rezent: im SW des Schwarzen Meeres. — Auch circumtropisch.

11. *Balanus spongicola* Brown — (Kolosváry, 1951, 1960/61, Davaide, 1963, Müller-Skalka-Gomoin, 1965). — MED fossil: Oligozän, Miozän, Pliozän und Pleistozän. — MED rezent: im Westbecken des Mittelmeeres.

12. *Balanus concavus* Bronn — (Kolosváry, 1952, 1960/61, 1962, Davaide, 1963, Müller-Skalka-Gomoin, 1965); in Ungarn in den nördlichen Gebieten und in Pannonien in Tortonien in Riesenwuchs zu finden (17 cm!) — G. Kolosváry). — Im Pliozän und im Quartär fehlt die irreguläre Form, im Miozän fehlt die Form *striata* (Frau Menisini). — MED fossil: Oligozän, Miozän, Pliozän und Quartär. — ARCA fossil: Oligozän und Miozän; diese letzteren Exemplare sind alle vollkommen epakmisch klein (Kolosváry). — Zur Zeit in Ozeanen zurückgezogen.

13. *Balanus vadászi* Kolosváry — (Kolosváry, 1952, Davaide, 1963). — MED fossil: in Nordungarn in Miozän und in Sausset, Sardinien, San Sebastiane di Isili in Miozän.

14. *Balanus trigonus* Darwin (Kolosváry, 1952; Davaide, 1963; Stublings, 1967) MED fossil: Miozän, Pliozän, in Nordungarn und Pannonien. — MED rezent: im Ostbecken des Mittelmeeres und im Golfo di Taranto in üppigen Populationen und von zoogeographisch wertvoller Art. Zur Zeit circumtropisch.

15. *Balanus eburneus* Gould (Kolosváry, 1951; Davaide, 1963; Stublings, 1967) MED fossil: Südtunesien aus Pleistozän-Schichten. — MED rezent: im allgemeinen. — PONT rezent: in SW-Teilen des Schwarzen Meeres. Ohne Unterarten.

16. *Balanus improvisus* Darwin (Kolosváry, 1951; 1951/a; 1952; 1955; 1962; Abricossow, 1959; Davaide, 1963) MED fossil: Pannonien in Oligozän-Miozän-Grenzschichten auf *Ostrea*-Schalen. MED rezent: im Mittelmeer an brackischen Stellen. — PONT rezent: im allgemeinen. — PONT fossil: Ukraine-Suskowci in Tortonien-Schichten. — ARCA fossil: in unteren Miozänschichten und ARCA rezent: im Kaspischen Meer mit Membraniporan-Bryozoen vergesellschaftet. Abundant, euryhaline Art — ohne Unterarten.

17. *Balanus crenatus* Bruguière (Kolosváry, 1952; Davaide, 1963) MED fossil: Oligozän, Miozän, Pliozän und Pleistozän; MED rezent: im Westbecken des Mittelmeeres (in der Adria nicht mehr vorkommend!).

18. *Balanus pannonicus* Kolosváry (Kolosváry, 1952) MED fossil: in Nordungarn in Miozänschichten selten.

19. *Balanus provisoricus* Kolosváry (Kolosváry, 1962) ARCA fossil: nur in Burdigalien und ebenfalls selten.

20. *Balanus rostratus* Hoek (Kolosváry, 1962) ARCA fossil: nur aus Kizil-Kos aus den unteren Miozänschichten. Mehrere Exemplare wurden gefunden. Zur Zeit nordisch.

21. *Balanus polyporus* Pilsbry (Kolosváry, 1962) ARCA fossil: unteres Miozän in mehreren Exemplaren.

22. *Balanus pictus* Münster (Kolosváry, 1952) MED fossil: Nordungarn und Pannonien — am Ende der Torton-Zeiten; ausgestorben.

23. *Balanus stellaris* Brocchi (Kolosváry, 1960/61; Davaide, 1963) MED fossil: Oligozän, Miozän, Pliozän, sowie Pleistozän. Ohne Unterarten. Ob sie noch lebt, ist fraglich.

24. *Balanus calidus* Pilsbry (Kolosváry, 1960/61) MED fossil: in Torton-Schichten von Bulgarien. — MED rezent: in Westbecken des Mittelmeeres. Ohne Unterarten.

25. *Balanus balanus* Linné (Synonym: *Balanus porcatus* Da Costa) = (Davaide, 1963; Müller-Skalka-Gomoin, 1965; David, 1967) MED fossil: in Miozän- und Pliozänschichten.

26. *Balanus mylensis* Seguenza (Kolosváry, 1960/61; Müller-Skalka-Gomoin, 1965) MED fossil: Italien, in Sardinien im Miozän, Pliozän und Quartär. — MED rezent: Sardinien. Intergierte Art.

27. *Balanus borsodensis* Kolosváry (Kolosváry, 1955) MED fossil: nur in Nordungarn im Miozän. Nur Operkularplatten vorhanden — so ist die Zugehörigkeit zu Subgenus *Balanus* fraglich.

Subgenus : *Semibalanus*

28. *Balanus (Semibalanus) balanoides* Linné (Kolosváry, 1962) ARCA fossil: in Burdigalien. Zur Zeit ist die Art nordisch.

Subgenus : *Chirona*

29. *Balanus (Chirona) unguiformis* Sowerby (Kolosváry, 1962; 1960/61; Davaide, 1963) MED fossil: vom Eozän bis Miozän einschliessend — doch selten.

Genus : *Acasta*

30. *Acasta schaferi d'Alessandri* (Kolosváry, 1952) MED fossil: Pannonien, im Miozän selten (von Herrn Geologen Dr, H. Horusitzky determiniert — die Artzugehörigkeit ist fraglich!).

31. *Acasta fischeri* Locard (Kolosváry, 1952). MED fossil: nur in Korsika in Miozänschichten (scheint mir auch eine zweifelhafte Art zu sein).

32. *Acasta formae D'Alessandri* (Kolosváry, 1952) MED fossil: nur aus Italien aus Miozänschichten gemeldet (scheint mir ebenfalls eine falsche Determination zu sein).

33. *Acasta hébertina* Millet (Kolosváry, 1952) MED fossil: nur aus Frankreich aus Miozänschichten gemeldet.

34. *Acasta sarda d'Alessandri* (Kolosváry, 1952) MED fossil: Italien, Oligozän. Sie kann auch als eine zweifelhafte Art aufgefasst werden.

35. *Acasta muricata* Seguenza (Kolosváry, 1952) MED fossil: nur in Sizilien im Pliozän gefunden.

36. *Acasta spongites* Poli (Kolosváry, 1951) MED rezent: im allgemeinen in Spongien vorkommend, aus der Adria von mir zum ersten Male im Jahre 1937 gemeldet. Sehr variierende und weit verbreitete Art. Es ist nicht ausgeschlossen, daß die vielen „ausgestorbenen" Acasten des Mittelmeeres mit der rezenten Art *spongites* identisch sind und nur die ehemalige große Variabilität demonstrieren.

Genus : *Chelonibia*

37. *Chelonibia testudinaria* Linné (Kolosváry, 1955; Stublings, 1967) MED fossil: Frankreich im Oligozän. — MED rezent: im allgemeinen auf *Thalassochelis imbricata;* in der Adria nur von August bis Dezember samt Wirtstier zu finden.

38. *Chelonibia depressa* Seguenza (Kolosváry, 1955) MED fossil: Italien in Miozän und Pliozänschichten.

39. *Chelonibia depressa* Seguenza (Kolosváry, 1955) MED fossil: in Sizilien in Pliozän.

40. *Chelonibia patula* (Ranzani) (Kolosváry, 1951) MED fossil: im allgemeinen und rezent ebenfalls; sonst zur Zeit hauptsächlich im Atlantik, bei Australien und bei Japan. Tropisch und subtropisch.

Genus : *Coronula*

41. *Coronula reginae* Darwin (Kolosváry, 1955) auf Wahlen. MED fossil: in Sizilien in Pliozänschichten gefunden.

Genus : *Chthamalus*

42. *Chthamalus stellatus* (Poli) mit seinen Biotopformen und — nach manchen Systematikern auch als „*Chthamalus depressus* Darwin" betrachtet — als eine selbstständige Art neben *Chthamalus stellatus* (Poli) lebend (Kolosváry, 1952; Menisini, 1965; Stublings, 1967). MED fossil: Sizilien in Pliozänzeiten. — MED rezent: im allgemeinen. — PONT rezent: nur stellenweise an salzigeren Fundorten neuerdings gefunden! Die Art is sonst auch als nordatlantisch bekannt.

Genus : *Creusia*

43. *Creusia rangi* Desmoulins (Kolosváry, 1952) MED fossil: Nordungarn und Pannonien, in Bulgarien aber nur in Tortonschichten zu finden; in Korallen synoekotisch. Eine biostratigraphische Bedeutung hat die Art wegen ihrer Abwesenheit.

44. *Creusia spinulosa* Leach (Kolosváry, 1952) mit sehr vielen fossilen und rezenten Formen. — MED fossil: Nordungarn, Pannonien, in Bulgarien aber ausschließlich in Tortonien samt Korallen synoekotisch — gefunden. Charakteristisch und bedeutungsvoll für die Stratigraphie der Tortonzeiten. Zur Zeit tropisch (Korallenzonen).

Genus : *Pyrgoma*

45. *Pyrgoma anglicum* Sowerby (Kolosváry, 1951; Stublings, 1967) MED fossil: Frankreich, Italien, Jugoslavien (Synonyme: *P. undata* Michelotti; *P. sulcatum* Philippi). — MED in Miozän rezent: im Westbecken des Mittelmeeres, sonst nordatlantisch, atlantisch.

Genus : *Tetraclita*

46. *Tetraclita squamosa* (Bruguiére) (Kolosváry, 1951; Stublings, 1967) MED rezent: stellenweise im Ostbecken des Mittelmeeres. Variable Art; sie scheint im Mittelmeere in Verbreitung begriffen zu sein.

47. *Tetraclita dumortieri* Fischer (David, 1967). — MED fossil: in Franckreich bei der Rhone in Miozänschichten gefunden.

Genus: *Verruca*

48. *Verruca strömia* (O. F. Müller) (Kolosváry, 1952; Porumb, 1956/59) MED fossil: in Sizilien im Pliozän! MED rezent: Golfo di Taranto (selten). — In Larvenstadien mehrmals aus der Adria (Kolosváry and Gamulin) und auch im Schwarzen Meere von Madame Porumb gefunden!

Die Hauptverbreitung des marinen Miozäns in Eurasien liegt an der Atlantischen Küste und im jetzigen Mittelmeergebiete, bis zu dem heutigen Schwarzen und Kaspischen Meere hinein sich ausdehnend. Ja sogar noch weiter ... Es bedeckte zwar noch Teile von Nordafrika, besonders Algerein, Nordägypten und Syrien. — Die während der Alttertiärzeit noch bestandene Verbindung der Thetys mit dem Indischen Ozean — hörte schon auf!

Im Pannonbecken wurde während der Sarmatischen Phase das Meer brackwasserartig, so, daß sich von Westen nach Osten eine verarmte Fauna entwickelte: d.h. die Balaniden wurden vollkommen vernichtet. — Weiter nach Osten bestanden beide Wasserstände die ganze Quartärzeit hindurch; die Angliederung des Pontus an das rezente Mittelmeer erfolgte erst in den Holozänzeiten durch tektonische Kräfte verursacht.

Die Balaniden des Pontus und Kaspi sind also sekundär hier eingewandert (Pontus) bzw. zurückgeblieben (Kaspi) — die einzige Art *Balanus improvisus* Darwin betreffend. — Der Umstand, daß einige Arten, wie z.B. *Balanus improvisus fossilis*, Kolosváry, nur auf *Ostrea*-Schalen vorkommen — scheint zu bedeuten, daß diese Art damals nicht in brackischen Gewässern gelebt hatte, also die tertiäre *Balanus improvisus* damals kaum eine euryhaline Art gewesen sein dürfte.

Zusammenstellugen

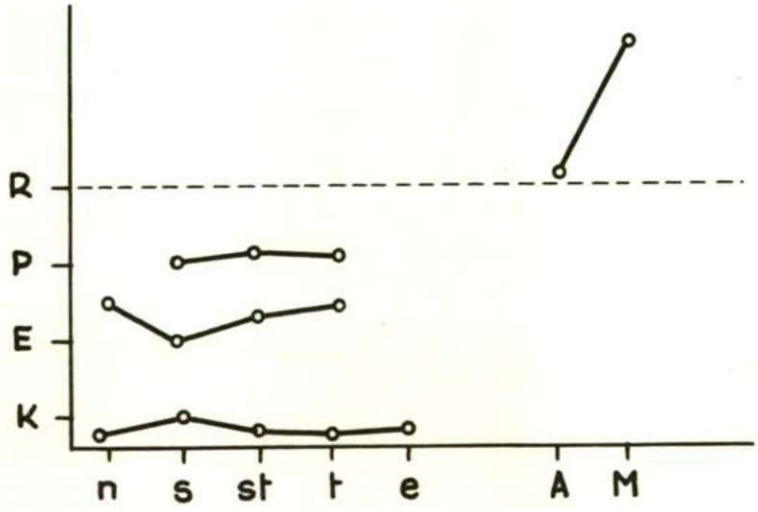
Betreffs der Arteigenschaften konnte ich in phylogenetischer Hinsicht — die folgenden Gruppierungen feststellen:

Konservative Arten: mit enger Variationsbreite und ohne Unterarten: 1 tropisch, 1 tropisch-subtropisch, 3 subtropisch, 2 endemisch und 1 nordatlantisch.

Elastische Arten: mit breiter Variation und guten Einpassungen, mit verschiedenen Verbreitungen: 5 tropisch, 3 tropisch-subtropisch, 1 subtropisch und 5 nordisch.

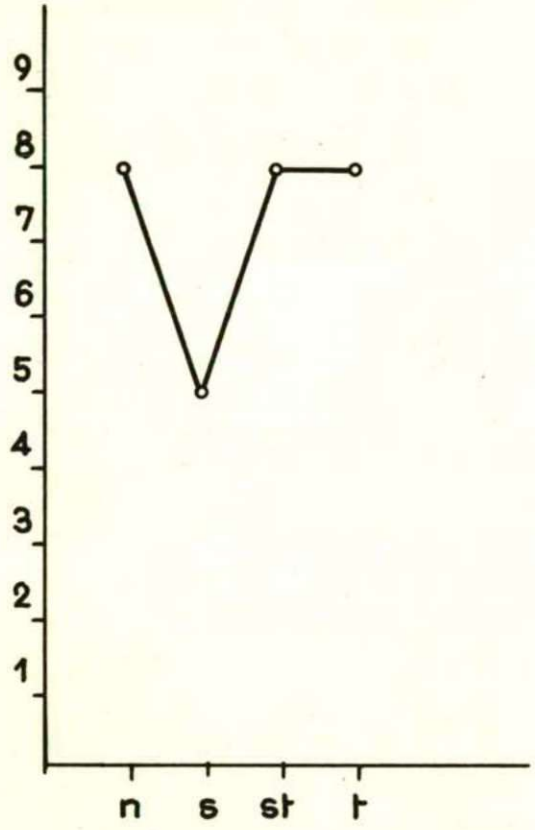
Progressive Arten: weit verbreitete Arten mit vielen Unterarten: 2 tropisch, 2 subtropisch-tropisch, 1 atlantisch.

Regressive Arten: die ausgestorbenen u. zw.: 2 aralokaspische und 19 mediterrane Arten (Graphikon 1).



Es wurden also 9 Genera, 5 Subgenera und 48 Arten betrachtet. Davon leben noch 27 Arten und sind 21 ausgestorben. Von den lebenden sind nordisch 8; tropisch-subtropisch 6; tropisch-circumtropisch 8; nur subtropisch 5 und fraglich nur 1, zusammen 27 Arten. — (S. Graph. 2.) — Es leben jetzt im Mittelmeere 20 Arten, davon im Westbecken nur 5

— im Ostbecken nur 2 Arten. — Es ist also eine Absonderung in West- und Ostbecken auch auf Grund der Balaniden festzustellen. — Es leben jetzt im Pontus 4 Arten und im Kaspi nur 1 Art.



Eine geographische Balaniden-Rangreihe ist also: tropisch — circumtropisch — nordisch — tropisch — subtropisch. — Es sind phylogenetisch beurteilt 8 als konservative, 14 als elastische, 5 als progressive und 21 als regressive Arten aufzufassen (insgesamt 48 Arten).

Das 3. Graphikon, d.h. das der Lebenden bildet also eine typische Gauss-Quetelet'sche Kurve (8—14—5) und eine Absonderung der ausgestorbenen Regressiven gibt eine maximale Anzahl von 21.

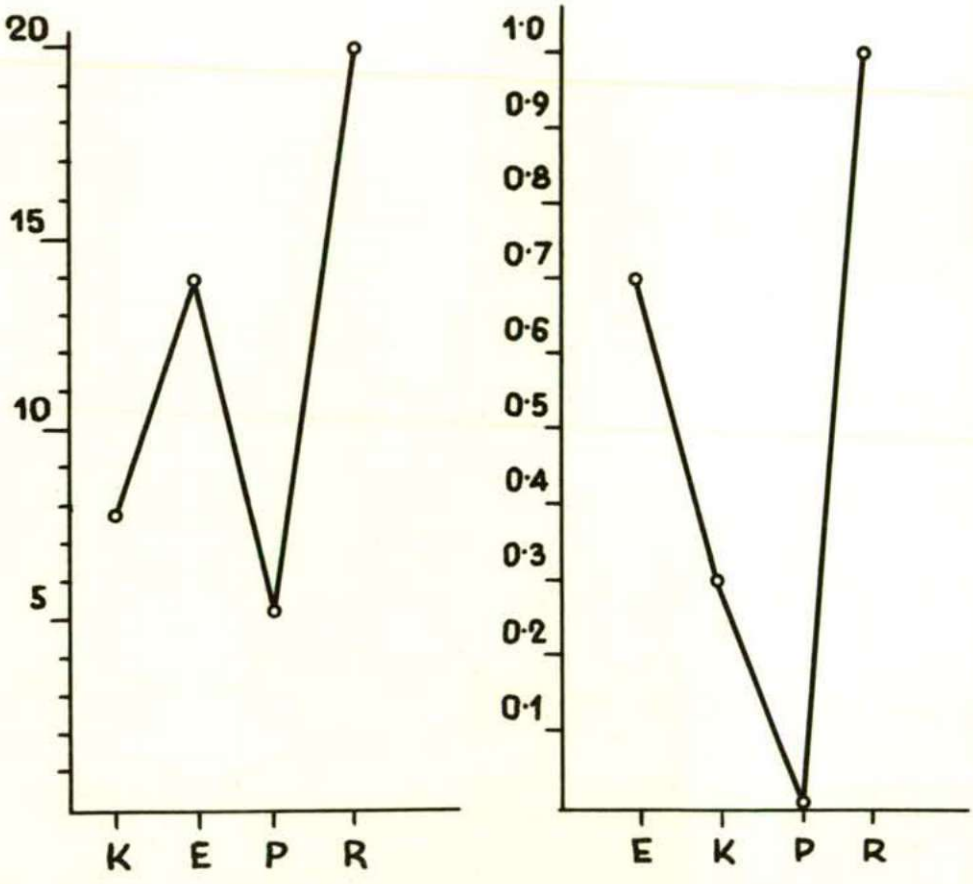
Nach Proportionsanzahlen gruppiert kommen wir zu den folgenden Resultaten:

Progression zum Konservativismus	5:8	1:1.3
Elastizität zur Regression	14:21	1:1.7
Konservativismus zur Elastizität	8:14	1:1.6
Progression zur Regression	5:21	1:2.6

Tabellarisch dargestellt:

Elastizität	Konservativismus	Progression	Regression
1 — 1.7	1 — 1.3	1 — 1	1.6 — 2.6
0.7	0.3	0	1

Ein relatives Gleichgewicht zeigt der Index 0.3—0; einen Mittelwert zeigt der Index 0.7 und ein Extrem zeigt der Index 1.



Meine Ergebnisse sind nur erste Schritte zum Verständnis der Entwicklung der Fauna unseres geforschten Gebietes. Die Gruppierung der Arten nach verschiedenen Gesichtspunkten — und hauptsächlich auf Grund der phylogenetischen Eigenschaftsreihe (Konservativismus, Elastizität und Progression-Regression) — scheint mir ein guter Ausgangspunkt in der Beurteilung unserer biologischen Probleme überhaupt zu sein.

Die große Anzahl (Index 1) der ausgestorbenen (regressiven) Arten spiegelt die Regression des ehemaligen miozänen Mittelmeeres und ein relatives Gleichgewicht zwischen konservativen und progressiven Arten (Indexe 0.3—0) sowie eine Anpassung der am Leben gebliebenen Arten (Index: 0.7).

Die neuesten Erscheinungen betreffs der Balanidenfauna ins Pontokaspimediterraneum sind:

a) Auftreten der Art *Chthamalus stellatus* im Pontik;

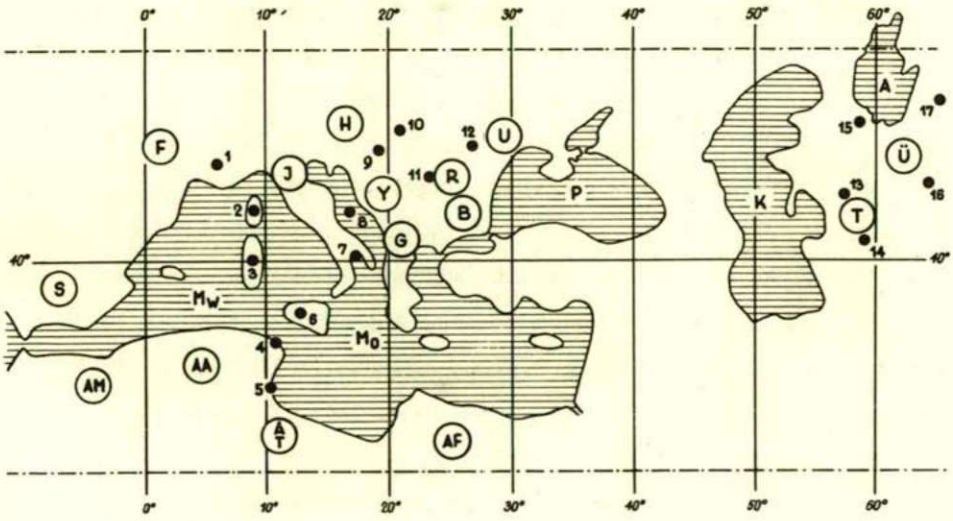
b) Auftreten der Larven der Art *Verruca strömia* in Pontik und Adria;

c) Auftreten der üppigen Populationen der Art *Balanus trigonus* im Golfo di Taranto;

d) Auftreten vieler tropischer Arten in Fossilien;

e) Weitere Bestärkung der Absonderung zwischen West- und Ostbecken des Mittelmeeres in zoogeograpischer Hinsicht.

Auf Grund dieser Befunde kann man feststellen, daß die Balanidenfauna des Pontocaspimediterraneums seit dem Ende der Tortonzeiten im heutigen Mittelmeer aus mehreren regressiven, prolongierten, konservativ — und elastisch — adaptiven Arten besteht, selbst von komplexen Gesichtspunkten beurteilt.



Kartenerklärungen:

MW	Westbecken des Mediterraneums	G	Griechenland
MO	Ostbecken des Mediterraneums	H	Nordungarn und Pannonien
S	Spanien	AM	Marokko
F	Frankreich	AA	Algier
I	Italien	AT	Tunesien
Y	Jugoslavien	AF	Nordafrika

P	Schwarzes Meer	T	Turkmenistan
U	Ukraine — Suskowci	Ü	Üzbekistan
R	Rumänien (Transsylvanien)	Ar	Aralsee West
B	Bulgarien	A	Aralsee
K	Kaspisches Meer		

Einzelne Fundorte:

1	Rhone	10	Ungarn N
2	Korsika	11	Siebenbürgen
3	Sardinien	12	Suskowci
4	Cap Blanc	13	Kizil-Kos
5	Tunesien	14	Karakum
6	Sizilien	15	Kuzha-Bach
7	G. d. Taranto	16	Kuldniztage
8	Adria	17	Kizil-Kum
9	Pannonien		

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Anschrift des Verfassers

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WEITERE KONSTITUTIONSSTUDIEN AN BALANUS IMPROVISUS DARWIN AUS DER OSTSEE

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(Eingegangen am 20. Februar 1968)

Einleitung

Im September des Jahres 1967 hatte ich Gelegenheit, auf der Insel Rügen und Hiddensee an der Ostseeküste Norddeutschlands mehrere hundert Exemplare von *Balanus improvisus* Darwin aufzusammeln und in konstitutionsvariationsstatistischer Hinsicht später in Szeged — Ungarn — zu studieren. Bei den Sammlungen waren mir meine Frau und Herr Kollege Dr. H. J. Subklew aus Greifswald erfolgreich behilflich, wofür ich ihnen beiden an dieser Stelle meinen besten Dank ausspreche.

Meine Ostsee-Balanidensammlungen erfolgten an den N- und NW-Uferpartien der Insel Hiddensee, sowie im Hafen von Sassnitz und bei Kap Arkona auf der Insel Rügen. Dieses Material dient als Vergleichsgut zu meinen früheren ähnlichen Ergebnissen an *Balanus improvisus* aus dem polnischen Baltikum, dem rumänischen Pontik und aus den ungarischen und russischen Oligozän-Miozän-Schichten (Kolosváry, 1962; 1966; 1968). Die Umstände in diesen drei Gebietsteilen und zwei geologischen Epochen sind verschieden, die Ergebnisse aber im allgemeinen gleich wie folgt:

a) Fossiles Material kommt nur auf *Ostrea*-Schalen vor, und so erscheint es wahrscheinlich, dass *Balanus improvisus* damals stenohalyn gewesen sein dürfte.

b) Wegen der *Balanus*-Bänke gibt es im rumänischen Pontik sehr zahlreiche Execplare von *Balanus improvisus* auf *Mytilus edulis* (normal gewaschen) und auf *Aloidis* (zwergwüchsig) — dominierend!

c) Im Baltik finden sich nur zwergige Exemplare von *Balanus improvisus* in grossen Mengen auf *Mytilus edulis* (ebenfalls zwergige Exemplare) und auf anderen zwergwüchsigen Lamellibranchiaten, sowie auf Strand- und Fischerei-Holzpfählen unter dem Enteromorpha-Niveau — aund außerdem auf *Fucus*.

Meine hiesigen Untersuchungen und Beobachtungen sowie Ergebnisse beziehen sich ausschließlich auf die freien Ostsee-Küstenpartien der Inseln Hiddensee und Rügen und sind nur auf Grund der Variationserscheinungen der Konstitutionstypen des Balanidengehäuses durchgeführt und erreicht worden.

Ich habe juvenile, semiadulte und adulte Exemplare gemeinsam in Betracht gezogen, weil bei Kunstitutionsforschungen die ontogenetischen *Epakme-*, *Akme-* und *Parakme*-Stadien kaum eine störende Rolle spielen können, da sie keinen systematischen Wert besitzen. Zur Zeit konnte ich die Exemplarzahlen der polnischen und rumänischen Materiale (d.h. 5000 und 12.000) nicht erreichen, hielt

aber das jetzige Material (ca. 5000 Exemplare) für Variationsstudien für ausreichend. Die Ursachen der Variationen sind schon bei 100 Exemplaren ersichtlich und im wesentlichen ändern sich die Resultate auch bei mehr als 100, 1000 oder auch bei 10 000 Exemplaren schon nicht mehr.

Die Konstitutionstypen: Pyramiden, Zylinder und Trichter sollen hier, um zwecklose Wiederholungen zu vermeiden, nicht eingehender besprochen werden, ich verweise diesbezüglich auf meine früheren Abhandlungen (Kolosváry, 1966; 1968).

Ich muß aber noch auf die Arbeiten des berühmten ungarischen Forschers Prof. Dr. Cs. Anghi — Budapest — mit Hinsicht auf seine tierischen Konstitutionsstudien in ähnlichen Konzeptionen aufmerksam machen (Anghi, 1962; 1967). N. Homonnay und L. Sasvári-Schäfer hatten sich ähnlicherweise mit den tierischen Konstitutionen in der ungarischen Literatur befaßt (Homonnay, 1964; Sasvári-Schäfer, 1966).

Das Hauptkriterium der konstitutionellen Eigenschaften ist, daß sie nicht von systematischem Wert sind, d.h. bei ihnen weder von Art-, noch von Subart-Merkmalen die Rede sein Kann! Der Umstand, daß die Typen P, C und T keine systematischen Taxone sind, macht es selbstverständlich, daß sie nur konstitutionelle Unterschiede beweisen.

Besprechung des Materials

I. Das Kap-Arkona-Material entstammt der Insel Rügen, gesammelt am 11. 9. 1967 vom Verfasser, von seiner Frau und von Herrn Dr. H. J. Subklew. Die maximale Größe der Balaniden betrug 9—12 mm. Wir sammelten insgesamt 85 Exemplare — sie saßen auf Mytilen und *Fucus*. Hier besteht die Küste der freien Ostsee aus Kreide-Geröllsteinen, dazwischen auch mit Fossilien von Cephalopoden und Echiniden und ausgeworfenem Detritus von *Fucus, Zostera, Prosellaria, Polysyphonia, Ceraminea, Mytilus*, Lamellibranchiaten mehrerer Arten, Gastropoden, Gammariden, Membraniporen usw. — Die Qualifikations-Tabelle der aufgesammelten Arten gestaltet sich folgendermassen:

Ansiedlungsoberflächen	Pyramiden	Pyr/Zyl	Zylinder	Zyl/Tri	Trichter	Anmerk.
Fucus	5	25	4	1		
?	5	8	2	1		isoliert gef.
Mytilus	1	18	4	1		
	11	51	10	3		zusammen

Dominant war der Hybriden-Typ P/Z.

Der reine Typ T fehlte wegen der geringen Individuenzahl von 85 vollkommen.

II. Das Hiddensee-Material stammt aus Aufsammlungen des Verfassers und seiner Frau vom 15.—17. 9. 1967 an freien Ostseeküstenpartien und der N-NW-Seite der Insel. Die Küste bestand hier ebenfalls aus

Kreidegeröllstein mit Detritus und Gesellschaftungen von: *Zostera, Fucus, Enteromorpha, Gammarus, Mytilus, Hydrobia, Littorina, Isopoda, Membranipora,* sowie Lamellibranchiaten-Arten. Die Maximalgröße der Balaniden betrug 6 mm. Das Verhältnis zwischen unbesiedelten und besiedelten Mytilen betrug 10.000:125, d.h. 100:1,25.

Die Verteilung nach Konstitutionstypen der aufgesammelten 217 Exemplare ist die folgende:

Oberfl.	Pyramide	Pyr/Zyl	Zylinder	Zyl/Tri	Trichter	Anmerk.
Mytilus						
edulis	57	115	35	7	3	
						Zusammen 217

Dominant war der Hybriden-Typ P/Z, der Reintyp T sprang — wegen des Materials von mehr als zweihundert — mit der Anzahl 3 ein.

Das Sassnitz-Material stammt von Holzpfählen aus dem Hafen von Sassnitz, gesammelt am 11. 9. 1967 vom Verfasser, von seiner Frau und von Herrn Dr. H. J. Subklew. Die Balaniden saßen unter der *Enteromorpha*-Zone und wurden zusammen mit Mytilen und Membraniporen gefunden. Höchstgrösse der Exemplare war 12 mm. Die insgesamt eingeholten 194 Exemplare zeigten folgende Typenverteilung:

Oberflächen	Pyramiden	Pyr/Zyl	Zylinder	Zyl/Tri	Trichter	
Holzpfähle	33	118	26	12	2	
Mytilus		3				
	33	121	26	12	2	Zusammen

Als dominant erwies sich der Hybriden-Typ P/Z; subinfluent sprang Reintyp T wegen des reichen Materials von annähernd 200 Exemplaren ein.

Zusammenfassung

496 Exemplare		Rein-Typen			Hybriden-Typen	
		P	Z	T	P/Z	Z/T
Kap-Arkona	85	11	10	0	61	3
Sassnitz	194	33	26	2	121	12
Hiddensee	217	57	35	3	115	7
Im Verhältnis		1.0	1.0		1	1
		3.2	2.6	2	2	3.3
		5.6	3.5	3	1,4	2.1

Qualifikationen	a)	Progressiv	Konstanz	Modifikativ
„	b)	Nach Mengen steigernd		Mengen-unabhängig

Die Unregelmässigkeit der Hybriden ist von einer Dominanz in Mengen begleitet (121, 115, 51); die Unregelmäßigkeit des Hybriden-Typs Z/T ist wegen der Seltenheit des Rein-Typs T regressiv. Diese Umstände sind bedingt durch die Natur der Hybridisation gegenüber den Ursachen der reinen Typen (P, Z, T), die nach den Regeln von Quetelet-Gauss eine naturalle, proportionelle Verteilung in Mengen besitzen.

Ein Vergleich der hiesigen Ergebnisse mit den früheren ergibt folgende Resultate-tabellarisch dargestellt:

Fundort und Häufigkeit	Dominanzverhältnisse	Anmerkungen
Poln. Baltik PPCC	P subdominant	
	P/Z subdominant	
	Z *dominant*	
	Z/T subinfluent	
	T subinfluent	
Rumän Pontik PPC	P subdominant	
	P/Z *dominant*	
	Z influent	
	Z/T subinfluent	
	Z subinfluent	
Greifswald PCCCT	P subinfluent	Fundort
	P/Z subdominant	500 Exempl. Ryck!
	Z *dominant*	
	Z/T subdominant	
	T subinfluent	
Deutsch. Baltik PPCC	P subdominant	
	P/Z *dominant*	
	Z subdominant	
	Z/T subinfluent	
	T subinfluent	

Die beiden baltischen Ergebnisse ähneln sich also bezüglich der Häufigkeit der Typen PPCC; die pontischen (PPC) und Ryckschen (PCCCT) scheinen sich von den baltischen absondern zu lassen. Es hat sich also ein natürliches Bild ergeben wie Baltik, Ryck und Pontik.

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ANTHROPOLOGICAL INVESTIGATION OF THE SKELETAL MATERIAL OF A CEMETERY AT BAJA-PETŐ FROM THE XI—XVI CENTURIES

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In Spring 1959 the Army informed the István Türr Museum in Baja that in the course of military earthworks some skeletons had been found in the environs of Baja, in the area called Pető. The rescue excavations were carried out by the archeologist of the Museum of Baja, Mihály Kőhegyi, from 1959 till 1962. The cemetery was not excavated completely, but its excavation was to be ended for technical reason. In the course of that work, also the remains of the church-wall of the settlement were found.

The age of the cemetery is estimated by Kőhegyi, on the basis of findings, to originate from the centuries XI—XVI. The long use of the cemetery is shown also by the multiple overburying. The most part of graves were disturbed but it is unceratain in which time it happened exactly.

The graves are mostly without any findings. Here I give an enumeration of findings found in graves containing skeletal material well preserved; anyway, the archeological elaboration of them has not been carried out, as yet.

Grave No. 30: Bronze sister-hooks on the cervical vertebrae;

Table 1. Anthropological material of the cemetery at Baja-Pető from the centuries XI-XVI

Characterisation of the material		Inf.I.	Inf.II.	Juv.	Ad.	Mat.	Sen	Undeter-minable	Total No.	p.c.
Fragmentary crania /unmeasuered/	Males	-	-	-	7	5	1	1	14	/15/
	Females	-	-	-	10	9	-	3	22	/23/
	Undeterminable.	13	20	10	-	-	-	15	58	/62/
	Total:	13	20	10	17	14	1	19	94	
Well preserved crania /measuered/	Males	-	-	-	27	27	6	-	60	/52/
	Females	-	-	-	21	13	2	-	36	/31/
	Undeterminable.	2	9	8	-	-	-	-	19	/17/
	Total:	2	9	8	48	40	8	-	115	
	Sum-total:	15	29	18	65	54	9	19	209	
		17 p.c.	14 p.c.	9 p.c.	31 p.c.	26 p.c.	4 p.c.	9 p.c.		

Table 2. Baja-Petõ: Distribution of the principal metrical characters

Characters				Males	Females	Total
8 : 1 Cranial index	Hyperdolichocranic		65,0-69,9	3 /7 p.c./	-	3 /5 p.c./
	Dolichocranic		70,0-74,9	10 /25 p.c./	5 /20 p.c./	15 /23 p.c./
	Mesocranic		75,0-79,9	18 /45 p.c./	14 /56 p.c./	32 /49 p.c./
	Brachycranic		80,0-84,9	7 /17 p.c./	5 /20 p.c./	12 /19 p.c./
	Ultrabrachycranic		90,0-x	1 /3 p.c./	-	1 /1 p.c./
	Hyperbrachycranic		85,0-89,9	1 /3 p.c./	1 /4 p.c./	2 /3 p.c./
			Total	40	25	65
17 : 1 Length-height index	Chamaecranic		x-69,9	11 /28 p.c./	3 /12 p.c./	14 /22 p.c./
	Orthocranic		70,0-74,9	20 /51 p.c./	17 /71 p.c./	37 /59 p.c./
	Hypsicranic		75,0-x	8 /21 p.c./	4 /17 p.c./	12 /19 p.c./
			Total	39	24	63
17 : 8 Breadth-height index	Tapeinocranic		x-91,9	11 /28 p.c./	8 /35 p.c./	19 /31 p.c./
	Metriocranic		92,0-97,9	19 /49 p.c./	11 /48 p.c./	30 /48 p.c./
	Acrocranic		98,0-x	9 /23 p.c./	4 /17 p.c./	13 /21 p.c./
			Total	39	23	62
9 : 8 Fronto-parietal index	Stenometopic		x-65,9	3 /8 p.c./	5 /21 p.c./	8 /13 p.c./
	Metriometopic		66,0-68,9	12 /31 p.c./	7 /29 p.c./	19 /30 p.c./
	Eurymetopic		69,0-x	24 /61 p.c./	12 /50 p.c./	36 /57 p.c./
			Total	39	24	63
47 : 45 Facial index	Hypereuryprosopic		x-79,9	-	2 /25 p.c./	2 /8 p.c./
	Euryprosopic		80,0-84,9	2 /12 p.c./	1 /13 p.c./	3 /13 p.c./
	Mesoprosopic		85,0-89,9	9 /57 p.c./	2 /25 p.c./	11 /46 p.c./
	Leptoprosopic		90,0-94,9	4 /25 p.c./	3 /37 p.c./	7 /29 p.c./
	Hyperleptoprosopic		95,0-x	1 /6 p.c./	-	1 /4 p.c./
			Total	16	8	24
48 : 45 Upper facial index	Euryene		45,0-49,9	2 /9 p.c./	5 /42 p.c./	7 /21 p.c./
	Mesene		50,0-54,9	14 /67 p.c./	4 /33 p.c./	18 /55 p.c./
	Leptene		55,0-59,9	5 /24 p.c./	3 /25 p.c./	8 /24 p.c./
			Total	21	12	33
52 : 51 Orbital index	Chamaeconch		x-75,9	4 /12 p.c./	1 /5 p.c./	5 /10 p.c./
	Mesokonch		76,0-84,9	17 /52 p.c./	6 /30 p.c./	23 /43 p.c./
	Hypsiconch		85,0-x	12 /36 p.c./	13 /65 p.c./	25 /47 p.c./
			Total	33	20	53
54 : 55 Nasal index	Leptorrhinen		x-46,9	10 /32 p.c./	7 /41 p.c./	17 /35 p.c./
	Mesorrhine		47,0-50,9	13 /41 p.c./	7 /41 p.c./	20 /42 p.c./
	Chamaerrhine		51,0-57,9	6 /20 p.c./	2 /12 p.c./	8 /17 p.c./
	Hyperchamaerrhine		58,0-x	2 /7 p.c./	1 /6 p.c./	3 /6 p.c./
			Total	31	17	48
38. Calculated cranial capacity	Oligencephalic	x x-1300	x-1150	9 /25 p.c./	4 /17 p.c./	13 /22 p.c./
	Euencephalic	1301-1450	1151-1300	13 /36 p.c./	14 /58 p.c./	27 /45 p.c./
	Aristencephalic	1451-x	1301-x	14 /39 p.c./	6 /25 p.c./	20 /33 p.c./
			Total	36	24	60
72. Total facial angle	Mesognathous		80° -84,9°	4 /15 p.c./	1 /8 p.c./	5 /13 p.c./
	Orthognathous		85° -92,9°	23 /85 p.c./	12 /92 p.c./	35 /87 p.c./
			Total	27	13	40

Grave No. 88: Hair ring ending in shape "S";
Grave No. 91: Some vase fragments among bones;
Grave No. 99: Grey vase fragments made with potter's wheel;
Grave No. 106: Bronze ear ring made of straight wire;
Grave No. 107: Sister-hooks crooked of a thin bronze wire provided with hooks;
Grave No. 130: A thing of bronze with unknown destination;
Grave No. 144: Silver hair ring ending in shape "S", a bonze ring crooked of a smooth bronze ring;
Grave No. 165: Coffin nail, iron nail;
Grave No. 174: Coffin iron fittings, coffin nail, iron nail;
Grave No. 191: Iron nail.

In the graves containing fragmentary material resp. subadult persons, the following findings could be found, as well: money (?) broken in two; girl's head-

dress of 3—4 cm, bevoming narrower at the end of temples; leather belt with fittings; remains of leather clothes; iron ring; iron hooks; iron band; bronze plates.

I witsh to express here my thanks to Mihály Kőhegyi for having made his excavation diary available for me.

In the course of the excavation 230 graves were opened. From them the material of 209 graves has got into the Anthropological Institute of the Attila József University, Szeged. 55 percent (115) of the anthropological material is in good condition: 60 males, 36 females, 19 subadults and infants; 45 percent (94) are fragmentary. Data of sex, age and preservation are found in Table 1.

Table 3. Baja-Pető: Mean of the types

No. of measurements /Martin/	Measurements and indices	Males				Females			
		N	V	M	s	N	V	M	s
1.	Glabello occipital length	44	162-197	183,2	8,11	26	158-185	173,1	5,54
8.	Maximum breadth of cranium	43	120-155	139;6	6,49	25	127-146	134,4	4,29
9.	Minimum frontal breadth	43	88-104	97,4	3,35	25	86-101	92,1	4,48
17.	Basion-bregma height	41	121-143	132,0	5,56	24	118-134	126,5	4,49
38.	Calculated cranial capacity	37	1160-1620	1409,5	131,20	24	1091-1405	1230,8	88.71
45.	Bizygomatic breadth	22	122-141	132,4	5,40	15	115-129	123,0	4,00
47.	Face height	22	104-126	117,5	6,41	8	92-111	104,1	7,68
48.	Upper face height	31	59-78	69,2	4,71	14	58-68	63,8	3,60
72.	Total facial angle	27	83°-102°	$87,7^{\circ}$	3,81	14	83°-96°	$88,4^{\circ}$	3,65
8:1	Cranial index	40	66,3-90,0	76,5	4,81	22	72,4-84,9	77,5	3,59
17:1	Length-height index	39	64,2-80,2	72,5	3,78	21	68,6-78,4	73,2	2,58
17:8	Breadth-height index	39	84,9-104,7	94,5	4,77	21	88,0-102,3	94,4	3,78
9:8	Fronto-parietal index	39	63,6-79,1	70,4	3,54	21	64,9-75,9	68,9	3,00
47:45	Facial index	16	81,2-95,3	88,5	3,65	8	73,2-94,8	84,9	7,68
48:45	Upper facial index	21	47,8-57,6	52,8	2,70	12	46,7-57,1	51,4	3,62
52:51	Orbital index	29	71,0-96,8	83,2	6,32	19	72,5-106,2	86,2	5,62
54:55	Nasal index	32	39,6-75,0	49,3	7,07	16	41,6-58,9	48,0	4,24
63:62	Palatal index	19	66,6-95,8	85,3	8,25	9	68,3-100,0	87,8	11,20

General characterization

The elaboration of the material has been carried out with Martin's method (Martin, 1928), Hug's categories (Hug, 1940) being used for determining the mean values. Considering the data of Tables 2, 3 and 4, the general characterization of the series is as follows.

The *crania* of males are of medium length, medium breadth, medium height, mesocranic — being, anyway, a great many dolichocranic ones, as well — orthocranic, metriocranic. The contour of the *cranium* is in the vertical norm ovoid and pentagonoid. The development of *glabella* is, as a rule, of second and third degrees. The frontal is of medium breadth, eury-metriometopic. The *protuberantia occipitalis externa* is

Table 4. Baja-Pető: Distribution of morphological characters

Characteristics		Males N	Males p.c.	Females N	Females p.c.	Together N	Together p.c.
Norma verticalis	Ovoid	21	/47/	12	/46/	33	/47/
	Pentagonoid	16	/36/	14	/54/	30	/42/
	Ellipsoid	6	/13/	-		6	/ 9/
	Sphaeroid	1	/ 2/	-		1	/ 1/
	Sphenoid	1	/ 2/	-		1	/ 1/
	Total:	45		26		71	
Glabella	Broca 1	2	/ 5/	14	/54/	16	/23/
	Broca 2	15	/33/	10	/38/	25	/35/
	Broca 3	22	/49/	2	/ 8/	24	/34/
	Broca 4	5	/11/	-		5	/ 7/
	Broca 5	1	/ 2/	-		1	/ 1/
	Total:	45		26		71	
Fossa canina	1. Absent	3	/ 8/	3	/15/	6	/11/
	2. Slight	14	/40/	3	/15/	17	/31/
	3. Medium	17	/49/	9	/45/	26	/47/
	4. Deep	1	/ 3/	5	/25/	6	/11/
	Total:	35		20		55	
Alveolar prognathism	1. Absent	11	/31/	6	/31/	17	/32/
	2. Moderate	16	/47/	3	/16/	19	/36/
	3. Pronounced	7	/21/	10	/53/	17	/32/
	Total:	34		19		53	

mostly of first and second degrees. The capacity of *cranium* is aristen-euencefalic. The face is of medium breadth, medium height, meso-prosopic, mesene. The *fossa canina* is usually of medium depth, sometimes slight, the orbital cavity is meso-hypsikonch, the nose meso-leptorrhine. The alveolar prognathism is but moderate. On the basis of the total facial angle the face is rather orthognathic.

The *crania* of the females are of medium length, medium breadth, medium height, mesocranic — occurring anyhow dolichocranic and

brachycranic ones, as well — orthocranic, metrio-tapeinocranic. The contour of the *cranium* in the vertical norm is pentagonoid and ovoid. The *glabella* is of degrees 1 and 2. The frontal is eurymetopic, of medium bredth. The *protuberantia occipitalis externa* is mostly of degrees 0 and 1. As regards capacity, most *crania* are euencephalic. The face is of medium breadth, of small height, leptoprosopic, euryene. The *fossa canina* is of medium depth, sometimes deep. The orbits are hypsikonch, the nose is leptomesorrhine. The alveolar prognathism is pronounced, on the basis of the total facial angle, the face is orthognathous.

Table 5. Baja-Petős: Measurements of long bones (Males)

Grave No.	Inventory No.	Femur				Tibia		Humerus		Radius		Calculated stature
		greatest length		length in natural position		right	left	right	left	rigth	left	
		right	left	right	left							
25.	2666	425	432	424	430	352	343	325	370	242	-	162
27.	2668	453	449	449	446	364	-	324	319	245	240	164
28.	2669	475	483	470	480	383	384	330	339	251	255	169
30.	2671	482	490	481	485	392	390	337	346	252	-	170
33.	2674	-	-	-	-	-	-	300	306	-	219	156
34.	2675	-	-	-	-	-	-	313	318	232	241	162
44.	2684	478	473	480	474	366	368	347	-	250	-	162
45.	2685	445	445	443	444	364	365	324	330	248	243	165
52.	2691	439	-	438	-	366	365	-	-	-	249	165
64.	2703	435	436	434	435	354	-	305	309	-	-	161
68.	2707	423	425	422	422	351	348	300	309	239	238	161
74.	2713	440	-	435	-	357	-	-	320	248	242	164
78.	2717	453	450	448	443	361	362	317	-	-	-	164
79.	2718	-	489	-	488	-	-	362	365	267	-	178
81.	2720	445	446	442	442	343	345	321	321	230	231	164
87.	2726	457	467	452	462	370	373	318	321	244	-	165
97.	2736	-	-	-	-	365	-	334	331	248	-	156
99.	2738	440	436	439	433	363	364	364	319	243	244	166
100.	2739	-	-	-	-	365	-	338	336	-	-	166
104.	2743	462	464	458	460	-	-	321	318	-	242	165
106.	2745	-	-	-	-	-	-	320	320	243	244	164
107.	2746	446	448	444	445	355	355	335	330	247	242	165
108.	2747	416	414	414	413	349	346	-	-	233	231	160
114.	3180	409	415	406	410	345	311	-	-	237	238	160
117.	3183	436	436	435	433	438	334	314	308	-	-	160
120.	3186	421	425	419	421	335	324	313	309	228	227	159
123.	3188	418	414	415	412	335	-	300	-	-	-	157
126.	3191	450	454	449	450	360	354	334	328	245	249	165
127.	3192	424	429	422	424	336	340	308	-	-	-	159
130.	3195	425	424	423	421	330	326	304	303	224	227	158
131.	3196	395	396	394	394	353	359	324	-	251	250	162
132.	3197	452	464	451	462	371	374	346	348	256	259	170
142.	3207	438	-	436	-	355	-	316	-	233	-	162
148.	3213	440	439	438	438	353	355	-	-	-	-	163
157.	3219	428	-	425	-	-	-	307	300	227	-	159
165.	3229	487	494	486	493	396	395	-	345	272	279	163
169.	3975	444	440	439	439	368	368	320	328	247	245	165
178.	3984	-	472	-	470	-	371	-	329	249	-	167
186.	3992	438	441	434	439	349	352	318	313	224	227	157
187.	3993	414	420	411	418	340	343	-	-	-	222	157
190.	3996	448	446	441	440	367	369	-	-	238	-	164
196.	4002	-	-	-	-	-	-	-	341	261	259	172
201.	4006	469	465	468	464	367	366	323	327	239	236	167
204.	4009	471	470	465	468	397	398	358	358	259	258	174
215.	4020	465	460	464	459	-	377	348	343	260	-	169
220.	4025	514	520	504	513	427	427	-	-	-	-	179
222.	4027	426	424	420	419	338	-	-	295	-	224	158

A significant difference is in calculated stature of both sexes, changing between rather wide limits. Considering, at any rate, the mean values, it may have been mediocre both in case of males (165 cm)

Table 6. Baja-Petõ: Measurements of long bones (Females)

Grave No.	Inventory No.	Femur				Tibia		Humerus		Radius		Calculated stature
		greatest length		length in natural position		right	left	right	left	right	left	
		right	left	right	left							
24.	2665	-	412	-	409	-	-	-	-	-	-	153
26.	2667	-	395	-	392	-	330	299	-	219	-	153
31.	2672	-	-	-	-	319	315	-	286	-	-	149
39.	2679	447	446	445	445	360	359	-	-	-	-	160
58.	2697	387	390	385	386	308	315	-	-	-	-	147
62.	2701	370	373	366	371	-	361	269	-	204	205	145
63.	2702	420	424	416	420	336	335	291	295	222	218	154
70.	2709	390	390	386	386	322	321	283	278	199	203	148
76.	2715	384	-	380	-	315	323	275	-	206	199	148
77.	2716	-	383	-	380	-	-	-	276	-	-	145
80.	2719	410	410	407	408	335	330	288	-	212	-	153
88.	2727	421	423	416	420	330	333	306	-	220	-	155
112.	2751	433	440	431	439	350	350	313	310	-	-	158
118.	3184	380	383	378	380	308	310	285	278	206	204	147
119.	3185	443	-	437	-	-	-	303	303	-	217	156
124.	3189	400	402	398	399	303	304	-	286	-	-	148
125.	3190	-	401	-	398	323	324	-	-	-	-	151
128.	3193	376	-	370	-	310	-	270	268	-	-	143
129.	3194	400	400	399	401	335	337	306	304	229	-	153
136.	3201	-	-	-	-	333	-	293	-	226	-	156
149.	3214	-	-	-	-	347	-	306	-	233	238	161
159.	3221	-	398	-	-	-	-	281	278	222	220	152
167.	3973	461	459	453	453	-	374	-	-	244	248	165
174.	3980	407	406	405	401	341	340	301	299	216	219	154
181.	3987	404	-	401	-	-	-	290	292	214	215	153
182.	3988	-	431	-	428	-	343	302	304	-	-	156
188. 189.	3995	-	440	-	446	349	-	315	313	218	-	158
198.	4004	414	416	411	413	-	-	300	299	213	213	154
221.	4026	399	397	396	395	314	316	290	-	208	-	150
224.	4029	-	-	-	-	-	-	314	304	230	-	158
225.	4030	-	415	-	411	336	-	-	292	-	226	155
226.	4031	433	434	429	429	-	355	313	308	231	-	158
227.	4032	451	449	450	448	353	352	334	323	238	245	167

and in that of females (153 cm). Measurements of long bones and the calculated stature are contained in Tables 5 and 6.

In the *crania* there can often be noticed anatomical variations. At males we have from 60 cases: *sutura metopica* in 6 (10 p.c.), left *os epiptericum* in 7 (11 p.c.), right *os epiptericum* in 4 (6,6 p.c.), suture bones in 12 (20 p.c.), *os apicis* in 1 (1,6 p.c.), *torus palatinus sagittalis* in 2 (5,5 p.c.), suture bones in 6 (16,6 p.c.) cases. Both in case of males and in 2 (5,5 p.c.), left *os epiptericum* in 2 (5,5 p.c.), right *os epiptericum* in 2 (5,5 p.c.), suture bones in 6 (16,6 p.c.) cases. Both in case of males and in that of females, we could notice some flatness in the vicinity of the *lambda*, in a few cases.

Pressed for space, individual measurements and indices of males, females, subadults and infants, as well a schematic characterization of the fragmentary material are not published here.

On the basis of metric and morphological characteristics it can be established that the anthropological aspects of males and females are similar to each other. This is supported by the taxonomical analyzation, as well. In case of Bajapetõ, therefore, we are facing a rather homogeneous population. The preponderance of Mediterranean elements is characteristic both of the males and of the females (Table 7).

(1) *Mediterraneans:* They comprise 43,4 percent of the investigated material. They are more gracile than the Nordoids, with smaller absolute measurements (Plate I).

(2) *Brachycranic group:* They comprise 19,6 percent of the investigated material. Inside this group the Pamirian component occurs the most frequently (10,9 p.c.). The other sub-groups — Alpine, Lappid, Armenoid and undeterminable brachycranic components — are represented with 1—1 cases (Plate II).

(3) *Nordoids:* They are 17,4 percent of the investigated material. Big medium, tall stature, large absolute measurements of head, narrow face, dolicho-, resp. mesocranic are characteristic of them (Plate III).

(4) *Cromagnoid group:* They are 17,4 percent of the investigated material. Particularly the occurrence of the Cro-Magnoid-A component (10,9 p.c.) is characteristic while the Cro-Magnoid-B group could be observed only in 6,5 percent. Common characteritics of both components are the low and broad, squared face, as well the square, oblong orbits. While, however, those belonging to the Cro-Magnoid-A group are characteristically dolicho-mesocranic, those to the Cro-Magnoid-B group are moderately short-headed (Plate IV).

Table 7. Baja-Pető: Taxonomical analysis

Types (races)		♂	♀	Total N	Total p.c.
Mediterraneans /m/		8	12	20	/43,4/
Brahycranic group	Pamirian /p/	4	1	5	/10,9/
	Alpine /a/ - Lappid /1/	1	1	2	/ 4,3/
	Armenoid /ar/	1	-	1	/ 2,2/
	Undeterminable brachycranic component /br./	1	-	1	/ 2,2/
	Total:	7	2	9	/19,6/
Nordoids /n/		6	2	8	/17,4/
Cromagnoid group	Cromagnoid - A	5	-	5	/10,9/
	Cromagnoid - B	1	2	3	/ 6,5/
	Total:	6	2	8	/17,4/
Europoido-Mongoloid characteristics		1	-	1	/ 2,2/
	Sum-total:	28	18	46	

(5) *Europido-Mongoloid characteristics:* They have been observed only at one *cranium*, in the group of males.

I have undertaken the taxonomical analysis with P. Lipták's method (Lipták, 1962; Lipták, 1966) and helped by him. For all that I am most grateful to him.

The anthropological material of the cemetery at Baja-Pető from the centuries XI—XVI, if compared with the material of other cemeteries

of similarages, does not differ essentially from them. Taking into consideration the result of the taxonomical analysis, we find so that its material is the most similar to that of the cemetery at Orosháza-Rákóczitelep from the centuries X—XII (Table 8) (Bartucz-Farkas, 1956; Lipták-Farkas, 1962; Lipták-Marcsik, 1966; Nemeskéri-Deák, 1956).

Table 8. Baja-Petőfi: Comparison of Arpadian-age and Mediaeval findings

Site, time of excavation	Age Centuries	Author, time of publication	Mean value of cranial indices	Percentile distribution of cranial indices				Main taxons
				65,0–69,9 70,0–74,9	75,0–79,9	80,0–84,9	85,0–89,9 90,0–X	
Csongrád-Felgyő 1942-1943	XI-XVI	Bartucz-Farkas 1956	♂ : 77,3 /17/	24	53	23	-	Uralic, Turanian, Pamirian
			♀ : 76,0 /16/	31	63	6	-	East-Europid
Mohács-Csele 1949	XI-XV	Nemeskéri-Deák 1956	♂ : 80,4 /22/	20	35	35	10	Dinaric, Nordic, Cromagnoid-A, Cromagnoid-B
			♀ : 81,0 /11/	-	45	55	-	
Orosháza-Rákóczitelep 1961-1962	X-XII	Lipták-Farkas 1962	♂ : 74,3 /81/	60	31	5	3	Nordic, Mediterranean, Cromagnoid-A, Cromagnoid-B, Brachycranic
			♀ : 75,8 /69/	37	41	22	-	
Téglás-Angolkert 1962	XI-XIV	Lipták-B. Marcsik 1966	♂ : 77,3 /11/	55	18	9	18	Brachycranic, Cromagnoid-A, Cromagnoid-B, Nordic, Mediterranean
			♀ : 81,9 /15/	8	23	46	23	
Baja-Petőfi 1959-1962	XI-XVI	-	♂ : 76,5 /46/	32	45	17	6	Mediterranean, Brachycranic, Nordic, Cromagnoid-A, Cromagnoid-B, Europoido-Mongoloid
			♀ : 77,5 /22/	20	56	20	4	

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PLATE I

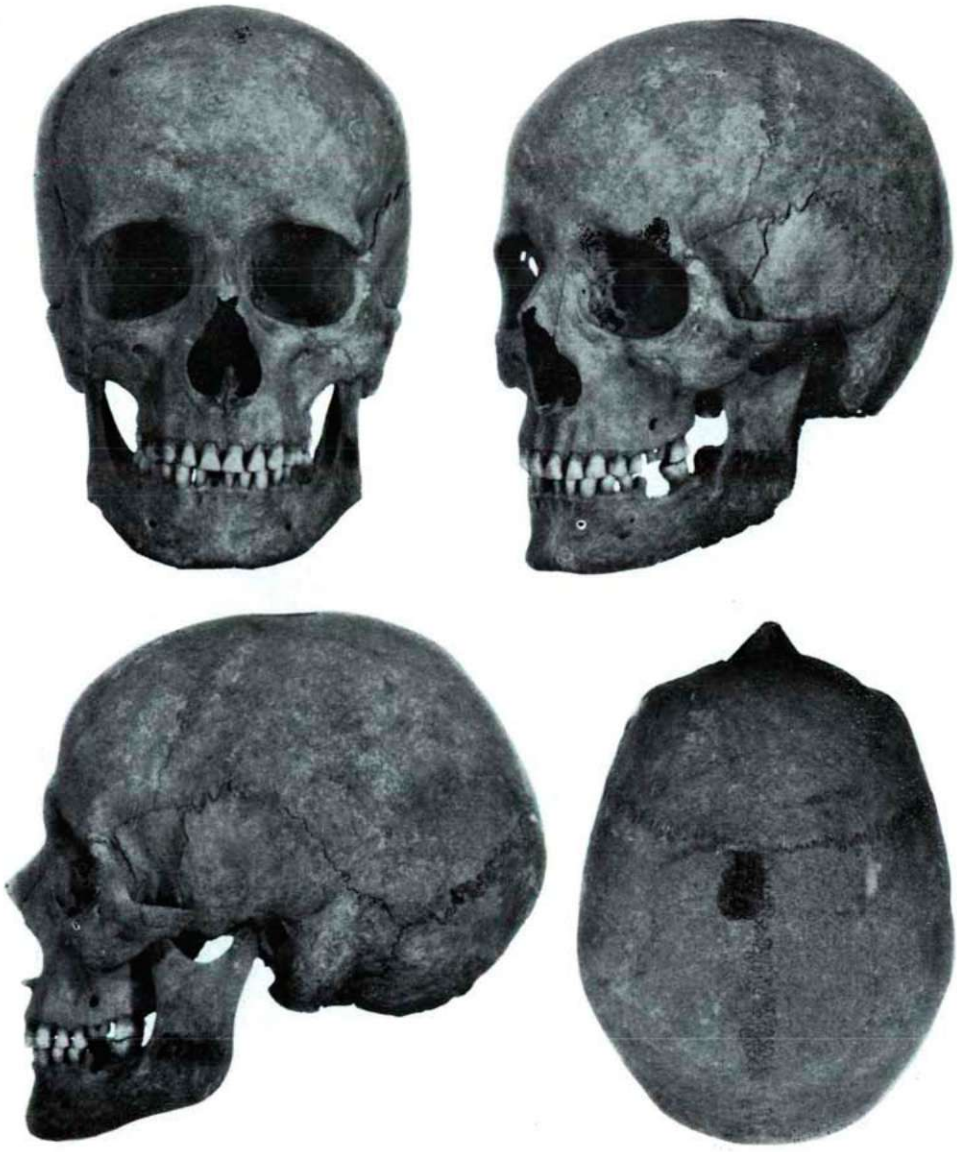

PLATE II

PLATE III

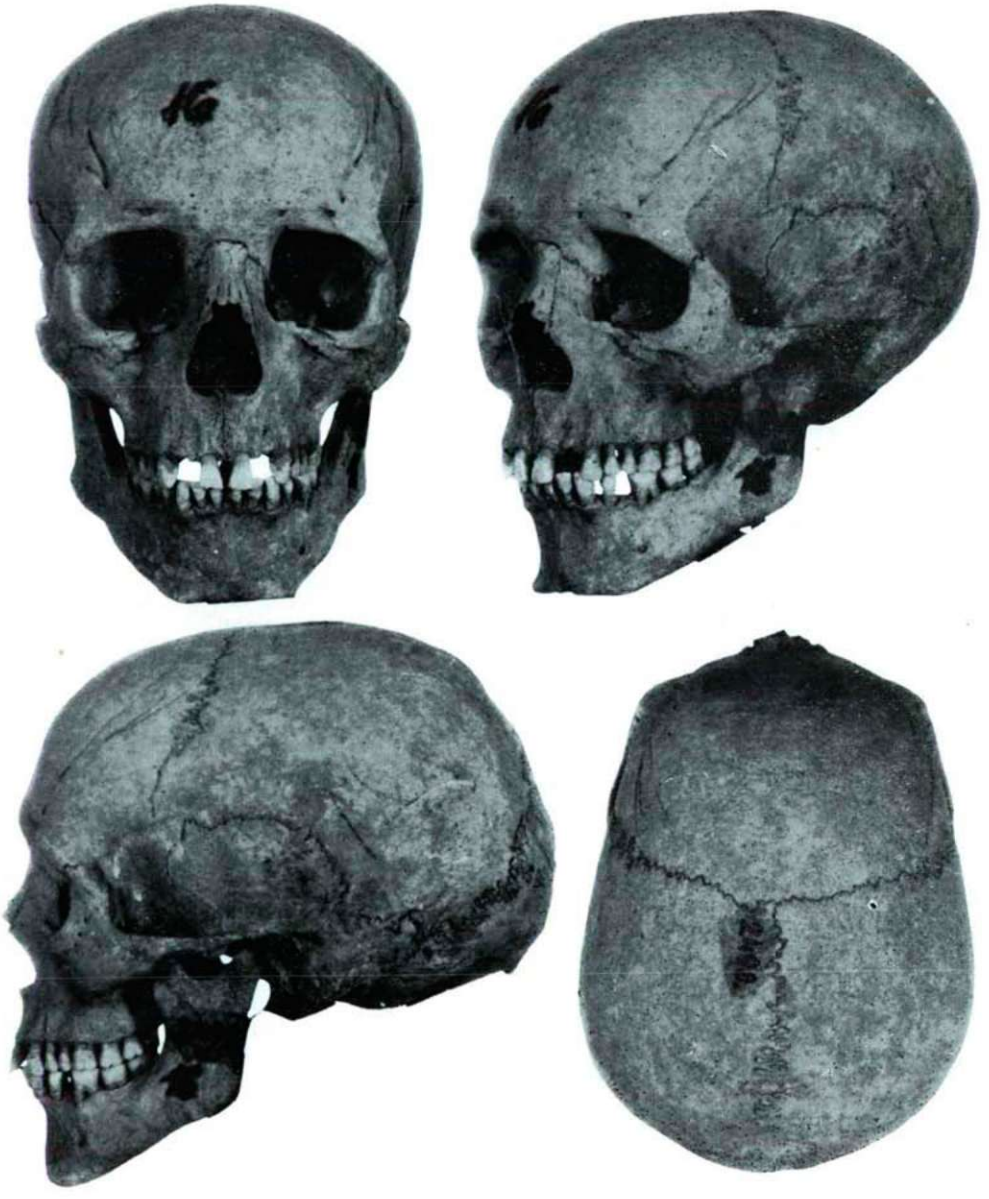

PLATE IV

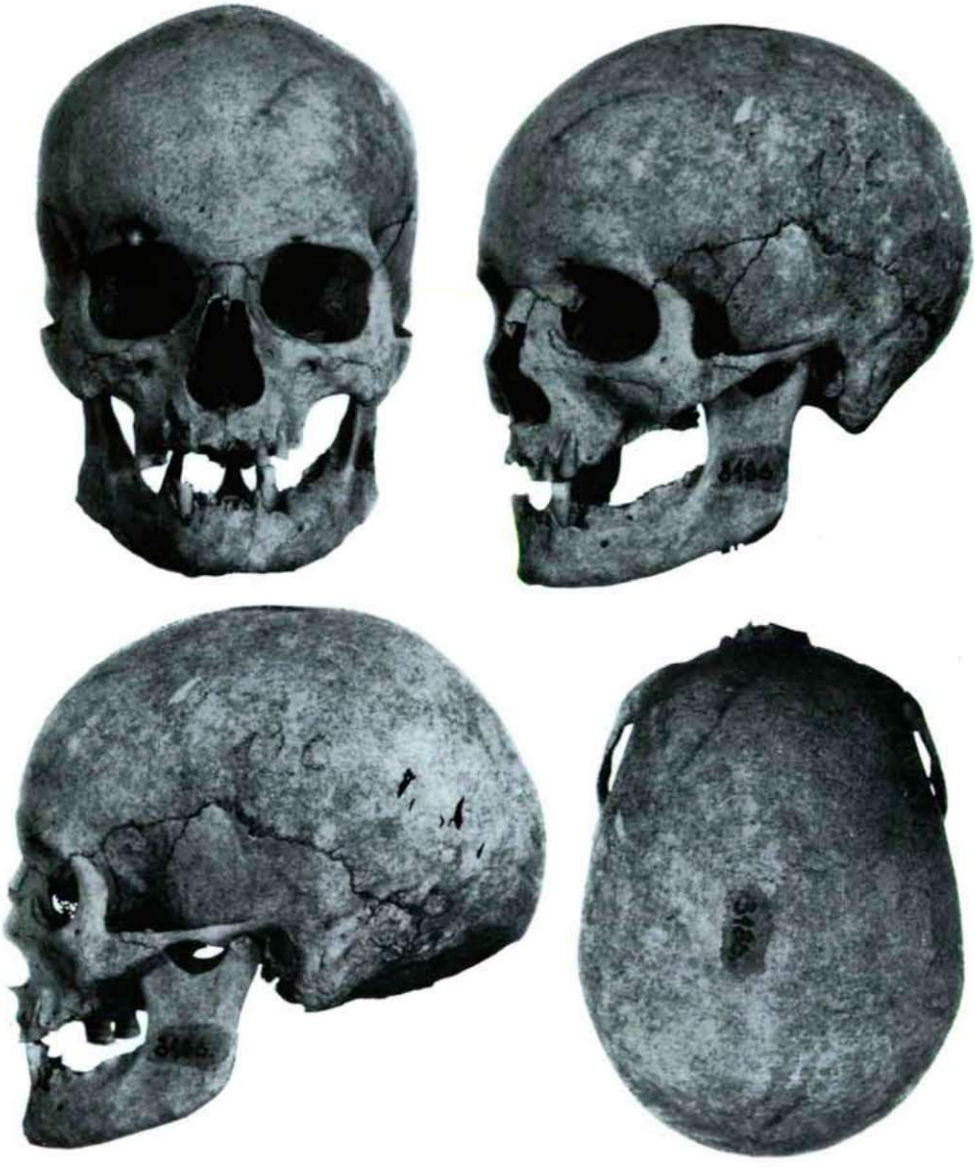

Plate I. Baja-Petőd XI—XVIth century
grave 81. m ♂

Plate II. Baja-Petőd XI—XVIth century
grave 28. p ♂

Plate III. Baja-Petőd XI—XVIth century
grave 16. n ♂

Plate IV. Baja-Petőd XI—XVIth century
grave 120. cr-A-x ♂

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